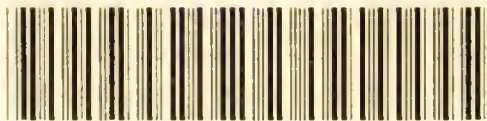


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THE NINE CIRCLES,
OR THE
TORTURE OF THE INNOCENT.

BEING

RECORDS OF VIVISECTION, ENGLISH AND FOREIGN.

COMPILED BY
G. M. RHODES.

SECOND AND REVISED EDITION.

WITH INTRODUCTION BY
EDWARD BERDOE, M.R.C.S., &c.

*Mostrarti mi convien la valle buia
Necessità m'induce e non diletto.*

—INFERNO, 12, 86.

London:
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PREFACE.

THIS work, originally issued by Miss F. P. COBBE, is now published by the Executive Committee of the Victoria Street Society. It has been carefully revised and enlarged by a sub-committee specially appointed for that purpose.

The object of the book is to give a bird's-eye view of the vivisectional method, and the reader must bear in mind that the extracts of which it is composed, do not describe isolated and exceptional instances of experiments, but are samples selected out of hundreds of others of similar character, as showing the different kinds of vivisection that have been and are now being practised in England, France, Germany, Italy, and America, and also as illustrating the class of mind and mental attitude of the professional physiologist, and the objects he has in view. That any immediate benefit to mankind is not contemplated by ordinary vivisection has, over and over again, been demonstrated. The justifiable impulse to demand some proof of the useful results to be derived therefrom, has recently been characterised by a leading vivisector as "the miserable spirit of *cui bono?*" Another has told us that science must advance, and the "question of the animal being sensitive, cannot alter the mode of investigation." This book will sufficiently show that, even where care is used, and of course still more in reckless unscrupulous hands, the infliction of pain amounting to torture, is unavoidable in this method of research.

The *Introduction* by Dr. Berdoo, sets forth the opinions and observations of the most eminent physiologists on the value

of chloroform, ether, morphia, and other anæsthetics; and from it the reader will be enabled to estimate how much or how little the anæsthetics can be relied on to reduce the amount of suffering caused by the various lesions, burnings, &c., to which the victims of vivisection are subjected.

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INTRODUCTION.

A stock phrase which is sure to recur in every discussion upon vivisection in England, is that all the cruelties take place abroad; that experimental physiology in this country, as compared with that which goes on in foreign laboratories, is as different as are the methods of English tax collectors from those of their Turkish or Russian counterparts. This we cannot admit. It is perfectly true that the reports of such experiments as are likely to reach the public eye in England are worded with much greater care than are those which are published in countries where, unhappily, there is little or no public feeling on the question; but English experimenters cannot reasonably claim to be considered more humane than their foreign *confrères* when they study in their schools, repeat their experiments, use the same methods, and pay honour to the perpetrators of the most cruel experiments. We find in *Nature*, for September 15th, 1892, a report of the International Congress of Physiologists, which took place at Liège, on August 29th, 30th, and 31st, and which was attended by more than 100 physiologists, "including:—Professor F. Holmgren (Upsala), President of the Congress, Professors Hensen, Hürthel, Kühne, Rosenthal, Cybulski, Kronecker, Milscher, Fredericq, Héger, Heyman, Arloing, Chauveau, Dastre, Gréhaut, Hédon, Langlois, Laulanié, Morat, Wertheimer, Hamburger, Grigorescu, Wedensky, and the following English members: Professors Michael Foster, Burdon Sanderson, Schäfer, Allen, Gotch, Halliburton, Horsley, Purser, Waymouth, Roid, Stirling, Waller, Drs. Adami, Beever, Paton, Martin, Mott, Pye-Smith, Sherrington, Starling, Shore, Sims Woodhead; Messrs. Bayliss,

Burch, and Parsons." We are informed that demonstrations of special interest were shown in the rooms of the laboratory, thus adding very materially to the pleasure and utility of the proceedings. At the meeting of Monday, August 29th, the Presidents, we find, were Professor Chauveau (Paris) and Professor Burdon Sanderson (Oxford). We are informed that one, Dr. Sherrington, gave a "demonstration" on the cortical representation of the movements of the hallux, and especially of the anus in the Macaque monkey, that Professor Schäfer made a communication on "the negative effects of severance of the frontal lobes of the cerebrum," that Professor Gotch communicated some information on "the increased excitability of nerve and of muscle occasioned by low temperature," and demonstrated "the increased excitability of the sciatic nerve of the cat produced by low temperature." "At the conclusion of the proceedings the members dined together in the large *foyer* of the theatre, the President of the Congress, Professor Holmgren, being in the chair." These particular experiments may or may not have been specially painful, but all this looks to the unsophisticated observer exceedingly fraternal and co-operative. Men with diametrically opposing tastes and interests do not "congress" in this fashion. We cannot imagine the Committee of "the Society for the Prevention of Cruelty to Children" hobnobbing with a select company of Mother Brownriggs, or the Protestant Reformation Society clinking glasses at the Vatican with the College of Cardinals.

It is only when they are disputing with Anti-vivisectionists that we hear from our opponents of this great gulf fixed between English and Foreign vivisection. At other times we find nothing but Fraternity and Equality. When Claude Bernard died, a letter appeared in the *Times* of March 20th, 1878, inviting subscriptions to raise a monument to his honour, signed by Sir James Paget, Dr. Burdon-Sanderson, Professor Humphry, Professor Gerald Yeo, Mr. Romanes, and Dr. Michael Foster. At the International Medical Congress, which met in London in 1881, Professors Goltz, Flint, Brown-Séquard, Béclard and Chauveau were received with the

warmest welcome from their English colleagues. When Professor Goltz returned to Germany, he published a volume containing the record of his experiments upon the brains of dogs, and dedicated it to

“HIS ENGLISH FRIENDS.”

Yet in an article in one of the reviews a few years ago, Professor Yeo says he “regards with pain and loathing such work as that of Mantegazza,” and, asks plaintively, “Why repeat the oft-told tale of horrors contained in the works of Claude Bernard, Paul Bert, Brown-Séquard, and Richet in France, of Goltz in Germany, Mantegazza in Italy, and Flint in America?”

If we go into a foreign chemical laboratory we find the methods in use are precisely those which are followed in England. Foreign medicine and surgery are for practical purposes, just the same as our own. An electrician's workshop is conducted on the same principles in Berlin as in Loudon. Why then are we expected to believe that physiologists pursue only perfectly humane methods here, and admittedly cruel and unjustifiable methods across the Channel? If it be objected that the methods are identical, but the Englishmen use anæsthetics—as I believe they do—more than the foreigners, we may reply that in doing so they possibly obtain less accurate results. French and German physiologists would hardly spend their lives in torturing animals from a mere lust of cruelty; the most “rabid Anti-vivisector” does not believe that. If their English brethren denounce the continentalists as cruel men, as I have heard them do, it can only be true in so far as the foreigners are more completely absorbed in their work than are our own researchers, and then it follows that the study of itself tends to make men cruel. Again, we often read protests from English men of science that the study of physiology is hampered in England by legal restrictions which they desire to see removed. They urge from time to time that our laboratories ought to be assimilated in scope

and usefulness to those of Paris, Strasburg, and Berlin. The Round Robin to the President and Council of the College of Surgeons which, four or five years ago, was signed by fifty eminent men of science, averred :

“It is a National discredit that we have nothing in London like the splendid laboratories which exist not only in the capital cities of Europe, but in comparatively small towns, such as Bonn, Strasburg and Leipsic.”

This is not the tone of men who repudiate and condemn the cruelties for which Strasburg and Leipzig are pre-eminently notorious. This in itself is a proof that the necessities of experimental physiology imperatively demand the freedom from the humane restraints which are found so irksome here. The vivisectors of England are not consistent when they attitudinise as humanitarians while agitating to be made like unto the confessedly inhumane experimenters of the Continent.

It is, however, upon the whole question of the use of anæsthetics that Anti-vivisectionists feel most strongly the attempts of their opponents to disguise the real facts of the controversy. We maintain that by casting a veil of humanitarianism over their proceedings many vivisectors seek to propitiate public opinion, and chloroform and ether, however administered and for however short a time, are made to cover a multitude of sins against mercy. How little, after all, the case against cruel experiments on living animals is modified by the alleged use of anæsthetics, will be obvious to the unprejudiced reader, who will study the evidence which follows. We hold that in many cases the anæsthetic either :—

1. Interferes with the results of the experiments.
2. Is dangerous to the life of the animal if given in sufficient quantity to neutralise pain. Or,
3. Cannot be maintained during more than a small portion of the time in which the pain continues.

Sir W. Fergusson, in his evidence before the Royal Commission, said (Q. 1,077):—“You cannot make a perfect experiment on the animal until it is in its normal condition.

It would be difficult for them to see what they want to see under anæsthesia, because the animal is no longer itself." Dr. Rose Bradford, recording experiments on the blood-vessels, says:—"The severity of the operation, the exposure of the cord, the hæmorrhage, the shock, and *anæsthetic*, all these must influence the delicate mechanism of the reflexes far more than they do the peripheral effects." That the use of anæsthetics and narcotics interferes with the results of physiological research is clear from such statements as the following. Mr. J. Sydney Edkins, M.A., M.B., Senior Demonstrator of Physiology in the Owens College, says†:—"But this has involved keeping the animal anæsthetised during the whole experiment, and to that extent causing the normal conditions of absorption to be diverged from. Again, the means of producing narcosis would have a considerable influence possibly on the normal processes. For the purpose of producing narcosis I have used morphia and atropine, with occasional whiffs of chloroform during an experiment. . . . The absolute value of my experiments is lessened, therefore, by the fact that the animals (and in all cases I used cats) were under the influence of morphia and atropine. This will not, I think, interfere with the relative results obtained, as the different animals were always placed under the same conditions." How the functions of the animal's digestive organs are disturbed by the chloroform, morphia, and atropine administered in Experiment XIII.† is explained by the experimenter. "In this case, one had to deal with an animal whose digestive processes were apparently abnormally prolonged. The milk, which was taken directly it was presented to the animal, was not got rid of by the stomach by 18 hours after it was swallowed."

Messrs. Roy and Sherrington record several facts of their own observation in connection with their experiments on the blood-supply of the brain, as to the influence of anæsthetics and narcotics on the cerebral circulation.§ Thus "CHLOROFORM," they inform us, "causes marked contraction

* *Journal of Physiology*, Vol. X., p. 399.

† *Ibid*, p. 458.

† *Ibid*, Vol. XIII., No. 5, July, 1892, p. 446. § *Ibid*, Vol. XI., p. 97.

of the brain, which is only in part due, so far as we have observed, to the fall of the blood pressure.

ETHER, "when injected into the vein . . . causes great expansion of the brain, which is probably due to the rise of venous pressure, which is likewise produced. When inhaled, primary contraction, lasting for a varying time, is followed by well-marked expansion."

"CHLORAL produces marked contraction of the brain."

"MORPHIA caused, when injected into a vein, contraction of the brain."

Messrs. Sewall and Sandford say,* "Anæsthetics and curare affect more or less profoundly the irritability of the whole vaso-motor mechanism, and from animals under the influence of such drugs, nearly all our data concerning the normal working of the vaso-motor apparatus have been gathered." Of course the necessity of keeping the animal anæsthetised during an important experiment is a little trying (to put it mildly) to an ardent researcher.

In the reports of some famous experiments on the biliary secretion of the dog the experimenter says, "Chloroform was used during the preliminary operation in two cases, but the stimulation of the liver which it induced rendered the experiments worthless. On the other hand we have abundantly proved that the doses of curare administered in the experiments have no influence on the biliary secretion and do not interfere with the effects of hepatic stimulants. It is therefore an exceedingly valuable auxiliary in a research of this nature."

Messrs. Gotch and Horsley say, *Croonian Lectures*, 1891, p. 349, "The statement that a narcotised cortex could in any way 'completely discharge' is always, of course, open to objection, and hence observations in animals narcotised to unconsciousness have been held by some to be incomplete."

Remarking the disadvantages of using large quantities of ether in such operations, and the danger of using chloroform, the writers say (p. 231), "The use of chloral or morphia

* *Journal of Physiology*, p. 186.

would undoubtedly entirely exclude any error of this kind, but it has the enormous disadvantage that it is impossible to alter the degree of narcosis, and, as will be seen, such alteration is an essential condition in experiments of the kind which we have undertaken."

In an article on Diabetes and Glycerine, by W. B. Ransom, M.A., Fellow of Trinity College, Cambridge, the writer says: "The operation was performed after Eckhard's method, which, in accuracy and facility, is superior to that preferred by Blenan. The animal being anaesthetised by the injection of about 0.5 gm. chloral hydrate into the rectum, the muscles of the back of the neck were dissected aside; the occipito-atloid membrane was exposed, and cut open, and the fourth ventricle (of the brain) being thus made visible, was punctured at the desired spot. . . . In the first two experiments, owing to a fear of making too severe a lesion, the results were not sufficiently marked for quantitative analysis; but later on I found it quite possible to produce a more extensive injury without causing death, and obtained, accordingly, better results." The experimenter explains, in a note, that since chloral reduces Fehling's solution, precautions had to be taken to prevent it vitiating his results; even then he can only say "it may be considered practically certain that no unabsorbed chloral got into the urine of the following hours."—*Journal of Physiology*, Vol. VIII., p. 104.

Chloroform is so dangerous to dogs that Professor Pritchard, M.R.C.V.S., giving his evidence to the Royal Commission, said: "With regard to dogs, I should never think of applying chloroform at all; I should think it very unsafe to do so. The dog has an intermittent pulsation; the heart's action is intermittent." (Q. 796—803.) Mr. F. R. Lewis, M.B., F.R.S., Assistant Professor of Pathology in the Army Medical School, lamented that chloroform is so very fatal to rats and rabbits, as also to puppies and young dogs. He said: "Even in large healthy dogs we calculate on losing one in five through this cause alone." No artist or mechanic would like his delicate work to be in peril of instant destruction, and if it were in his power to safeguard it by any possible precaution, we are sure

he would adopt it; in the same way it is impossible to imagine a delicate research on a living animal permitted by an ardent vivisector to be imperilled by too much chloroform.

Professor Rolleston, M.D., F.R.S., said* : "It is not so easy a thing to know when you have an animal thoroughly anaesthetised; and what is more, some animals recover with much greater rapidity than others of the same species from the same doses of anaesthetics." . . . "The whole question of anaesthetising animals has an element of uncertainty about it."

Dr. Haughton, who had himself been a vivisector, said before the Royal Commission: "I know the practice is to use the anaesthesia very imperfectly, and when the controlling eye is gone to drop the use of it altogether." (1,884.) Dr. de Noë Walker said on the same occasion: "When an experimenter says, for example, as is said in a very recent publication, that 'before and throughout these experiments anaesthetics were used,' it is perfectly true; but if by that you choose to understand that while the animal lived and was experimented on, he was throughout insensible, it is the greatest delusion that ever was." (1,810.) Dr. Hoggan (4,107-8) thought "anaesthetics do more to lull public opinion than to mitigate animal suffering." That in fact they were on the whole rather curses than blessings to animals, and he gave the Royal Commission the following grounds for this opinion. He said (4,108): "The public have generally supposed that anaesthetics were used, and they did not feel called upon to make any demonstration to save animals from pain, and while the animals were suffering pain, all the time the public really thought that nothing of the kind was going on, and consequently anaesthetics had served more to lull the public than the animals. And the reasons why anaesthetics were not so much used as they were supposed to be, were first, that anaesthetics if given to animals in many cases bring about a fatal result before the experiment can be concluded,—if given thoroughly, that is to say; in the second place, that

* *Royal Commission* (1,349-50).

anæsthetics cannot very well be given unless a special assistant is there for the purpose; and that these two things together cause so much annoyance to the experimenter that he does not take the trouble of thoroughly anæsthetising the animals. This leaves out of sight that great class of experiments where anæsthetics would interfere with the true result of the experiment, and these are very numerous." Dr. Pavy said it was difficult to draw a definite line when chloroform could or could not be used (2,177-9). Painful experiments, said Sir James Paget (293-7), Mr. Gamgee (5,358), Dr. Tarver (3,138), and Sir George Burrows (162), are sometimes necessary, and some experiments on the nerves of sensation are necessarily painful.* Anæsthetics would have frustrated Sir C. Bell's demonstrations on the nerves.† Of course they would interfere with experiments undertaken to discover the action of many poisons.‡

In the middle of most severe experiments, the animals are allowed to recover, for example: Dr. Isaac Ott, Fellow in Biology, Johns Hopkins University, Baltimore, U.S., in a paper "On the Physiology of the Spinal Cord," made the following experiments on cats. The animals were "etherised, and the various columns of the cord divided in the dorsal region, usually between the sixth and seventh dorsal vertebræ. The bony vertebral canal was opened by a trephine and cutting forceps, the bleeding being checked by styptic cotton. . . . After the section, the instrument was removed and the wound immediately sewed up. The animal was placed in a warm place, *and left to recover from the anæsthetic.* (Italics ours.) At the end of five hours it was bound down, the medulla oblongata was divided just below the point of the calamus scriptorius, and irritated by an induction-current derived from a Du Bois apparatus run by a single Daniell cell. Artificial respiration was kept up before the section of the

* Pavy (2,182-4), McDonnell (4,586-8), Burrows (144, 194-7, 251), Watson (53-6), Sharpey (513).

† Watson (47-50), Sharpey (408-9).

‡ Watson (53-6), Taylor (1,241, 1,188-9).

medulla to diminish bleeding, and afterwards to preserve the life of the animal."—*Journal of Physiology*, Vol. II., p. 63.

Messrs. Langley and Diekiuson experimented with pituri and nieotin. They say: "Our experiments have been made upon anæsthetised animals." "In the rabbit the effects of anæsthesia is more marked than in the cat and dog; in light anæsthesia .2 or even .1 mg. of pituri may cause a slight alteration in the breathing, but in profound anæsthesia several mgs. may be given and produce a very slight effect. When pituri or nieotiu causes convulsions in the rabbits, the muscles of the chest are usually involved, so that, as noticed by Rosenthal, there is strong inspiratory tetanus." "A moderate dose of nieotin abolishes the light reflex for a variable time in all three animals experimented on. To observe this the animal must, of course, not be in a too deep stage of anæsthesia."—*Journal of Physiology*, Vol. XI., p. 265.

"If the animal struggle while under the influence of a weak dose of curare, or when it is under either ehloroform or morphia alone," &c.*

Drs. Langley and Lee Diekinsou speak † of "light auæsthesia" and "profound auæsthesia." They explain ‡ that their results are affected by "the degree of anæsthesia." They mention also § "fairly deep auæsthesia," "moderate," and "deep" anæsthesia. Dr. Edkins speaks || of using "morphia and atropine with occasional whiffs of ehloroform during an experiment."

Referring to the after sufferings of animals which had been anæsthetised during the preliminary process, Sir W. Fergusson said in his evidence before the Royal Commission (1,079): "When a person having undergone an ordinary surgical operation recovers from it, then he suffers just the same in every respect as if he had not had ehloroform at all during the performance of the operation.—In the after suffering, you

* *Journal of Physiology*, Vol. XI., p. 93.

† *Ibid.*, p. 282.

‡ *Ibid.*, p. 287.

§ *Ibid.*, p. 291.

| *Ibid.*, Vol. XIII., p. 446.

mean?—In the after suffering; and there I think there is a great weakness on the part of those who try to make it appear that vivisection of the lower animals may now be more readily done than it could be before, because an experiment at the time of an animal being insensible is really of little or no value."

The use of the drug *curare* is so frequently referred to in the following reports of experiments that it is as well to say it was not considered an anæsthetic by those who first observed and recorded its effects. Claude Bernard is now declared to have been wrong in his conclusions made after his careful experiments, that curare paralysed the nerves of motion, while it left the nerves of sensation more alive to suffering than before, but is extremely valuable to the experimenter as a means of keeping the animal motionless as a corpse while he performs his work. We are told now, that curare is an anæsthetic itself. We are also told that the whole enquiry must start afresh from experiments on *Amœbæ* and the lowest forms of life. Be it so, we are not "researchers," and claim no authority to decide such a point.

Professor Gamgee, before the Royal Commission, said that he had performed some experiments with curare, on children, and that in consequence, he "was able to determine, very decidedly, that sensibility was not at all impaired; although there was a certain amount of paralysis of motion produced by the curare, there was no affection of the sensory nerves."—*Report*, Q. 5,407.

We shall require something more than the *ipse dixit* of the new school of physiologists before we accept the convenient explanation of interested vivisectioners in opposition to the positive experiments of such physiologists as Claude Bernard and Professor Gamgee as to the non-anæsthetic influence of curare. When a committee of experimental physiologists has deputed one or two of its members to submit to a painful experiment performed under curare alone we shall listen more respectfully to its decision.

It is not within the scope of this work to discuss the utility of these experiments; but it may not be out of place—and certainly not without interest to the reader—to give the opinion of one of the greatest discoverers in physiology which England has ever produced, and who was also one of the most humane of surgeons—Sir Charles Bell, the discoverer of the functions of the motor and sensory nerves.

In his treatise "On the Nerves of the Orbits," read before the Royal Society, June 19th, 1823, he said: "In concluding these papers, I hope I may be permitted to offer a few words in favour of anatomy, as better adapted for discovery than experiment. The question lies between observation and experiment, and it may be illustrated by astronomy and chemistry. In the first, the objects being beyond our influence, we make observations, not experiments, and the science at length attains a state of perfection which raises our estimate of the human intellect. In the latter, for the most part, the subjects lie out of the sphere of natural influence; they must be brought together by artifice, and chemistry becomes a science of experiment. But anatomy is more allied to the former than to the latter science, inasmuch as things are obvious to the eye. In the animal body the parts present distinct textures, and are laid in a natural and perfect order; it is necessary only to trace the tubes, or to observe the symmetrical order of the nervous cords, that we may discover their respective uses; the motions, whether of the solid or fluid parts, are so regular and uniform that the whole offers a subject for observation and induction. Anatomy is already looked upon with prejudice by the thoughtless and ignorant: let not its professors unnecessarily incur the censures of the humane. Experiments have never been the means of discovery, and a survey of what has been attempted of late years in physiology will prove that the opening of living animals has done more to perpetuate error than to confirm the just views taken from the study of anatomy and natural motions. In a foreign review of my former papers the results have been considered as a further proof in favour of experiments. They are, on the contrary, deductions

from anatomy; and I have had recourse to experiments, not to form my own opinions, but to impress them upon others. It must be my apology that my utmost efforts of persuasion were lost, while I urged my statements on the grounds of anatomy alone. I have made few experiments; they have been simple and easily performed, and I hope are decisive."—(*The Nervous System of the Human Body*. By Sir Charles Bell. Third edition. London. 1844. Pp. 183-4.)

In his paper "On the Functions of Some Parts of the Brain, &c.," Sir C. Bell says: "Seeing these contradictory effects, is it reasonable to expect constant and satisfactory results from experiments in which deep wounds are inflicted on the brain of animals, or portions of it torn away? Another source of error, especially to the experimenter on the brain, is the disturbance of its circulation; for the brain depends more directly than any other organ on the condition of the circulation within it. Now, by raising the skull, a necessary preliminary to most experiments on the substance of the brain, there is an immediate disturbance of the circulation, which, of itself, may be attended with insensibility or convulsions. Hence have been derived the weakest fancies that have ever obscured any science. It is obvious that we are in a state of profound ignorance of the most interesting functions of the animal body, notwithstanding the innumerable experiments which have been made upon the brains of animals."—(*Ibid.*, p. 209.) Two of the greatest practical surgeons of our generation, Sir William Fergusson and Mr. Lawson Tait, have recorded their testimony to the same effect.

Professor Tait has declared that vivisection is a relic of rude barbarian ages, that "it has not helped the surgeon one bit, but that it has often led him astray."

EDWARD BERDOE, M.R.C.S., &c.

March 4, 1893.

REPLY

TO

PROFESSOR HORSLEY'S CONCLUSION OF HIS LETTER IN THE *TIMES*, OCTOBER 25TH, 1892.



OBJECTION.

ANSWER.

1.

Page 3, *Nine Circles*. Dr. Hale White.—His own description of his method begins, "An anæsthetic was given, usually ether." *Nine Circles* omits this sentence or any mention of anæsthetics.

The experiments are taken from Vol. XII. of the *Journal of Physiology*. The sentence about an anæsthetic is found in Vol. XI. and not unnaturally escaped notice. But sometimes the experiments lasted three, four, seven, twelve, and even twenty-one days. Of course, the anæsthesia would not have been maintained for any such periods.

2.

Page 4. Professor Schäfer.—The *Nine Circles* quotes, "We destroyed as completely as we could from the surface by the actual cautery the grey matter of one angular gyrus," and omits the immediately following sentence: "We tested the sight immediately after complete recovery from the anæsthetic."

The sentence about testing the sight after recovery from the anæsthetic was overlooked. The whole paper was unfortunately not in this case read.

OBJECTION.

ANSWER.

3.

Page 9. Professor Ferrier.—Destruction of parts of the brain. This is one of a series in which the anæsthetisation of the animals by chloroform is constantly referred to, yet in the *Nine Circles* this fact is omitted, although it reveals it by saying that the animal lay in a stupor for more than an hour.

Mrs. Rhodes must be acquitted on this head, if she *reveals* the fact of the anæsthetisation she cannot be convicted of *concealing* it. But we are told by the experimenter that the animal "indicates consciousness by grunting discontentedly" and struggling, &c. So that it was only partially anæsthetised after all.

4.

Page 18. Dr. Shore.—The *Nine Circles* describes abdominal operations on dogs. No mention of anæsthetic. In the original it states that every experiment was performed under morphia and chloroform.

This was taken at second-hand from another report where the question of pain was not under discussion.

5.

Page 26. Dr. Bradford.—In his original paper, he states that the animal was anæsthetised with chloroform and morphia. The *Nine Circles* makes no mention of it.

But we have not always access to "original papers," and can only rely on such reports and extracts as are given in the medical and other journals. Even granting the preliminary chloroform, &c., this would not prevent the after-sufferings of the animals, which lived from a fortnight to six weeks after the operation.

6.

Page 27. Horsley.—Description of excitation of the brain after thyroidectomy. In my original it is stated that the animals were etherised. The *Nine Circles* makes no mention of it.

The compiler had no access to Mr. Horsley's "original paper;" she copied from the *Lancet*, which says nothing about any anæsthesia. Where is the "fraud" here?

Page 27. Horsley.—Division of thyroid nerves.—*Vide supra*.

The same answer.—*Vide supra*.

OBJECTION.

ANSWER.

8.

Page 29. Reference made to thyroidectomy experiments. This is taken from a critical review in which the method of operating is not described. In the original it is stated that the animals were etherised.

The experiments were copied from the *Lancet*. Not being gifted with omniscience, the compiler was not wise above what is written therein. Her mental vision did not penetrate to Mr. Horsley's desk or other receptacle wherein lay his original

9.

Page 30. Reference to experiments on the condition of nerves after thyroidectomy.—*Vide supra*.

Vide supra.

10.

Page 32. Mr. Rolleston.—The *Nine Circles* states [that] Mr. Rolleston proceeded to open "a window" in the chest of the living dog. The original stands, "chest of the anæsthetised and curarised animal."

Elsewhere in the paper it is stated that chloroform was the agent used.

The compiler did not believe that in this case there was any true anæsthesia. In common with many eminent scientists she believed that curarisation is inconsistent with effective anæsthetisation. She does not pretend to be wiser than Dr. Lauder-Brunton, for example, who said (*Evidence Royal Commission*, Q. 5,743-5,745): "If you give the wourali [curare], which paralyses the ends of the motor nerves, and give the chloroform, which paralyses the reflex centres, you deprive yourself of the possibility, in many instances, of making satisfactory experiments."

11.

Page 33. Dr. Haycraft.—The *Nine Circles* states that he opened the abdominal cavity of rabbits under curare. In Dr. Haycraft's paper he says they were also etherised.

Vide supra.

OBJECTION.

ANSWER.

12.

Page 49. Dr. Hime. — Description of inoculation by trephining after “M. Pasteur’s method.” The *Nine Circles* omits to state that this involves chloroforming the animal.

But the *British Medical Journal* says nothing about chloroform, and if a writer is to be accused of “fraud” in omitting to state everything which is “involved” or which might, could, would, or should be involved in an experimenter’s method, a new literary crime will be invented.

13.

Page 51. Mr. Shattock and Mr. Ballance. — In their original they state [that] the animal was etherised. The *Nine Circles* omits this.

In this case the cruelty was not the grafting operation done under ether, but the intention to produce cancer in the animals. It is merely throwing dust in the eyes of the public to expatiate on the humanity of men who gave ether while they were *grafting* portions of tumours in the animals. It was the effort to *inoculate cancer* of which Mrs Rhodes complained.

14.

Page 59. Dr. Bradford. — In his original paper, he states [that] the animal was anæsthetised with chloroform and morphia injected hypodermically. The *Nine Circles* omits this.

Here again, the omission to mention the anæsthetic can only in the smallest degree affect the case. The after-suffering in these experiments must have been great and prolonged. We read that some of the wretched animals lived on in misery “for as long as seven weeks after the operation.”

15.

Page 62. Messrs. Sherrington and Ballance. — They state that during each experiment, the animal was deeply anæsthetised. The *Nine Circles* omits it.

The compiler copied these experiments from a second-hand report, wherein the question of pain was not under discussion, and, wherein, the anæsthesia was naturally not referred to.

16.

Page 62. Messrs. Sherrington and Ballance. — Description of similar operation on the abdomen. Same omission.

Vide supra.

OBJECTION.

ANSWER.

17.

Page 66. Dr. Money.—The *Nine Circles* quotes only an abridged account, with no mention of anæsthetics. In the original paper it is stated: "The animal having been anæsthetised with ether or chloroform."

If experimenters would be so good as to forward copies of all their "original papers" to our office, it would avoid these misrepresentations. As it is, we can only depend on the reports in the medical journals, where the experiments are sometimes "abridged," a fact for which we cannot surely be responsible.

18.

Page 67. Drs. Roy and Sherrington.—In the original it is stated that the animals were, in most cases, under the influence of curare, in addition to an anæsthetic. In the *Nine Circles* the sentence is omitted.

In this case, the compiler says that the report was "abridged," the intention being to draw attention to the attempt to induce a painful disease which could not have been greatly influenced by the anæsthetic or the curare.

19.

Page 87. Messrs. Shattock and Ballance.—Feeding experiments described in *Nine Circles* as "poisoning." In truth, no pain whatever was caused, and the animals remained perfectly well.

But the animals were fed upon cancer, to see if the disease could be induced in them by that sort of feeding. It is the attempt—sometimes successful—in such experiments, to induce painful diseases, not the actual pain inflicted, which is deprecated here.

20.

Page 154. Professors Langley and Sherrington.—Description of cutting and stimulating nerves. Sentence omitted in *Nine Circles*—"All the experiments which are mentioned in this paper were made on anæsthetised animals."

These experiments were taken at second-hand from a report which did not mention the anæsthesia.

Two of Professor Goltz's experiments are next referred to.

OBJECTION.

ANSWER.

21.

Page 5. Description of various mutilations of the brain, &c. Sentence omitted in the *Nine Circles* runs—"All my experiments were performed on dogs, which I had chloroformed before the operation."

But the wretched, mutilated dogs lived for months. Most of them died of inflammation of the brain. A bitch "whined dolefully," "howled piteously;" others "foamed at the mouth," became blind, mad, &c.

22.

Page 159. Description of a dog in whom the spinal marrow had been destroyed. In the *Nine Circles* the sentence in which Professor Goltz states that the experiment was performed under chloroform anaesthesia is omitted.

The compiler is describing cruel experiments in amputating the breasts of mothers nursing their young. The chloroform did not prevent the paralysis or the after-suffering, neither of which, however, were under discussion. Attention was called to the "Moral Experiments on Animals" in cutting off the breasts of mothers, thereby disabling them from nursing their puppies, causing no doubt indescribable misery of the most piteous kind to the animals.

Such, when examined, are those errors in the original edition of the *Nine Circles*, on the strength of which the most violent language has been applied to the compiler and to the lady who paid for the compilation.

The reader will probably conclude that "the mountain has brought forth—a mouse," and that, in the face of the mass of horrors which the book records (concerning which no doubt has been raised), the display of indignation at the above omissions has been somewhat forced.

EDWARD BERDOE, M.R.C.S., &c.

March 4th, 1892.

FIRST CIRCLE.

M A N G L I N G.

*N.B.—The passages included in square brackets
[] are editorial comments.*

THE NINE CIRCLES

OR THE TORTURE OF THE INNOCENT.

M A N G L I N G

(A.)

OF THE BRAIN.

English. Dr. W. Hale White, Physician to and Lecturer on Materia Medica at Guy's Hospital, has recently destroyed portions of the brains of rabbits in some experiments on cerebral heat centres. "An anæsthetic was given, usually ether." —*Journal of Physiology*, Vol. XI., p. 1. "An incision was made through the superficial structures immediately in front of the ear. The skull was trephined close to its outer margin, the dura mater was incised, and the cortex destroyed immediately under the trephine hole. In a few experiments a considerable area of bone was cut away with forceps, and a large surface of cortex was destroyed. By these means the posterior part of the upper surface of the cerebrum was damaged" (Vol. XII., p. 245). There were 24 experiments of this nature. "The last three of these operations were very severe, for a large area of the cortex was destroyed" (p. 248). This "large area" was sometimes destroyed with a cautery, or a probe was "twisted about" in the cavity. Sometimes the experiment extended over three days. One day the probe was passed into the left side of the brain, the next day the probe was

passed into the right side of the brain, and the third day the animal was killed. Sometimes the experiment was continued over four days, seven days, twelve, and even twenty-one days. In some cases there were two trephine holes. "Cortex destroyed with cautery through trephine hole on left side over front part of brain"; "cortex destroyed with cautery through trephine hole on right side over front part of brain"; "cortex destroyed with cautery through trephine hole on left side in front of ear"; "cortex destroyed with cautery through trephine hole on right side in front of ear." All these were on the same rabbit. Again, sometimes, large pieces of bone were taken away before destruction of the brain area. "The operation is severe and a considerable loss of blood is inevitable, and therefore shock may easily explain these low temperatures—unfortunately Nos. 19 and 20 were found dead in their cages a few hours after the operation. Hæmorrhage was the cause of death, although at the time of the operation it appeared as though all bleeding had been stopped. No. 21 was kept alive for five days" (p. 244). "The last three of these operations were very severe, for a large area of the cortex was destroyed" (p. 248). "Table X. Animal showed well-marked rotatory movements" (p. 255).—*Journal of Physiology*, Vol. XII., pp. 233-270.

English. Experiment 5. *Left angular gyrus* exposed and cauterised. The left eye was "secured."

"At the end of half-an-hour it (a monkey) was evidently wide awake but would not move unless touched. At this time it was removed from its cage and placed on the floor, where it began to grope about in a sprawling manner, knocking its head against every article in its path. . . . At the end of still another half-hour, while it was lying quietly in its cage, it was gently laid hold of without noise to attract its attention, whereupon it bounded away with an expression of fear or surprise, and ran full tilt against the leg of a table where it remained groping or sprawling for a few moments. It then again started off, and this time ran against the wall, against which it sprawled helplessly. Similar things were repeated.

. . . When a slight noise was made with the lips quite close to it, it darted off and came against the wall as before, where it lay down. . . . Creeping up to it cautiously without exciting its

attention, the observer made a slight whisper close to its face, whereupon it peered cagerly, but evidently remembering the results of running away, it crouched down and would not move. Half-an-hour later, when it was quiet in its cage, it started suddenly on being touched and ran its head into a corner, where it crouched."—*Philosophical Transactions of the Royal Society*, 1884, in a paper by Drs. Ferrier and Yeo.

English. Professor Ferrier, in his work on Cerebral Physiology and Pathology, wrote:—"I have to thank Dr. Crichton Browne for kindly placing at my disposal the resources of the Pathological Laboratory of the West Riding Asylum, with a liberal supply of pigeons, fowls, guinea-pigs, rabbits, cats, and dogs, for the purposes of my research. . . . The next experiment was made on a large, strong cat. The skull was removed, &c. The animal was *only partially narcotised*. My experiments had to be extended over a very great many different animals, &c. With or *without* chloroform the application of the electrodes apparently produced no effect; the animal remained perfectly quiet. Occasionally, during application of stronger currents, the animal exhibited restlessness and uttered cries. Exper. IV. The greater part of the right hemisphere of a full-grown cat is exposed. The animal lies breathing in a *semi-narcotised* condition, &c. Obs. 12. The animal exhibited signs of pain, screamed, and kicked out with its hind-leg, at the same time turning its head round in an astonished manner. Obs. 19. While the temporo-sphenoidal gyri were being further exposed the animal bit angrily, and gnawed its own legs. It did the same generally after irritation of the same parts. Obs. 20. In every case restlessness, opening of the mouth, and long-continued cries as if of rage or pain. Obs. 21. The animal suddenly starts up, throws back its head, opens its eyes widely, lashes its tail, pants, screams, and spits as if in furious rage. This observation was *several times* repeated. Obs. 25. The excitability of the brain was now well-nigh exhausted, and it entirely disappeared four hours after the commencement of the experiment, during which period the exploration was kept up uninterruptedly."—*Report of Royal Commission*, p. 220.

English. On the 12th of December Dr. Beevor and Mr. Horsley "read a joint paper, giving an account of their recent experiments on the brain of the bonnet monkey (*Macacus Sinicus*).” In this paper they continue the subject which they brought before the Society formerly in 1887 and 1888. The animals were put under ether, and had their skulls opened. The brain was cut through, and various portions of the brain substance stimulated. Forty-eight animals were experimented on. These were divided into eight different groups, according to the depth to which the stimulation of brain fibres was conducted. The object of the experiments was to discover the route taken by nerve fibres passing from the motor areas.—*Lancet*, Dec. 28, 1889 p. 1,355).

Foreign. Fifty-one dogs had portions of the brain hemispheres washed out of the head, the skull having been bored in several places. This was repeated four times; the mutilated creatures and their behaviour having been studied for months. Most of the animals died at last of inflammation of the brain or its consequences (p. 415). "Interesting" experiment on a delicately-formed little bitch; a considerable part of the left side of the brain extracted. Wire pincers were placed on a toe of the right hind foot, which she moved as if the pincers caused discomfort, but without uttering any sound. After a rest, the corresponding toe of the other foot was fastened in the same manner. She whined dolefully, and I took off the pincers. When for a second time I fixed them on the left hind foot and left them there, the little animal began to howl piteously; soon afterwards foamed at the mouth (p. 417). The dog last operated upon on the 5th October, appeared to be quite blind; died on November 10th. "The dissected brain resembles a lately-hoed potato-field" (p. 418). Little bitch last operated upon on the 26th May, and made nearly blind; dies on the 7th July of inflammation of the brain (p. 420). A dog last operated upon on May 30th; blind since then; dies on the 18th November.

(P. 424.) These mutilated animals, no longer able to scratch themselves, twist about in "the most ludicrous attitudes," without gaining their object (p. 428). A few of the dogs had attacks of madness after the operation, and these died in a few days (p. 433).

Pincers put on the toes, and other parts of the blind and mutilated dogs (pp. 439, 440). "I undertook these studies of the mutilation of the brain in order to refute the hastily formed theories of the celebrated physiologist Flourens, and I have attained that end." Professor Goltz, in a previous article to which he refers for an explanation of his method, says:—"All my experiments were performed on dogs which I had chloroformed before the operation." —From *Pflüger's Archives*, Vol. XIV., 1877, pp. 412-43. *On the destruction of the cerebrum, by Professor Goltz, of the Physiological Laboratory at Strasburg.*

Foreign. Professor L. Hermann, of Zurich, in the summer of 1874, made experiments on electric stimulation of the cortex. These experiments were all made on middle sized dogs and were six in number only; Professor Hermann's own reason being that "as they all produced similar results, there was no reason to increase the number of these cruel experiments" (*Pflüger's Archives*, Vol. X., p. 79). The first three dogs were allowed to bleed to death. The sixth dog died on the evening of the day of the operation. In dog No. 4 the wound was stitched up carelessly, as he was not expected to live. He was used five weeks later on for an experiment on salivary gland fistula, of which he died, because a careless assistant pressed upon the injured portion of the brain. The fifth dog was more carefully sewn up, and was used by Herr Luchsinger later on. Professor Hermann's experiments consisted in laying bare the cortex of the brain, stimulating it with electricity, and also irritating it with a glass rod dipped in nitric or acetic acid, or a sharp brass tube was driven in to a depth of a centimetre or a centimetre and a-half, and drawn out again, and the electrodes placed in the hole thus made. There is no mention of anæsthetics. —*Pflüger's Archives*, Vol. X., p. 79.

Foreign. Dr. Isaac Ott, late Lecturer on Experimental Physiology, Univ. of Pennsylvania, has (pp. 163-4) some "Notes on Inhibition." Here "cats were selected, bound down on Czermak's holder, etherised, tracheotomy performed, the skull

in the parietal region at its posterior part trephined, and the opening enlarged by the bone forceps. Artificial respiration was then set up, and a spear-shaped knife used to sever the corpora quadrigemina, thalami optici, and cerebral crura."—*Journal of Physiology*, Vol. III., pp. 163-4.

Foreign.

Experiment on Electrical Stimulation of the different layers of the cortex of the hemispheres. This research was undertaken by Dr. Ernst Asch and Dr. Alfred Reisser at the Animal Physiological Laboratory of the Agricultural School of Berlin. The experiments were performed on rabbits. Dogs were specially excluded. After exposing the brain it was irritated by electricity. "As regards narcotics," says the Report, on p. 194, "we chose two agents, producing at one time insensibility by pure ether, another time by a mixture of ether and absolute alcohol. In both kinds of narcosis we kept the animal so far conscious that the reaction of the pupil of the eye to electricity could be noted." On p. 197 we find the following details of another experiment performed on June 8, 1886, the victim on this occasion being a middle-sized rabbit.—"11 o'clock. Tracheotomy" [*i.e.*, opening of the wind-pipe.] "The animal, in order to hold it fast more easily, was secured in a pasteboard splint, through which the leg to be observed was drawn out. Narcotics employed—ether and alcohol. 11.40. Trephining was performed" [*i.e.*, opening of the skull] "over the right hemisphere in the ordinary situations. 11.55. The brain was exposed, and the animal awakened. The irritation of the most sensitive spot then induced strong contractions of the fore-paw. 12 o'clock. Irritation of the superficial grey substance followed by convulsion. Irritation of the white substance followed by feeble contraction. Irritation of the white substance—in the deep layers no response, or feeble contractions." "By still deeper irritation we obtained very strong contractions. The experiment was repeated several times." "12 o'clock (eight minutes after). Irritation of the grey substance on the surface, very feeble contraction." Then followed stimulation of the deeper layers until reaction ceased. This experiment also was "repeated several times. The other (left) hemisphere of the brain gave a like result."—*Pflüger's Archiv.*, Vol. XL., 1887, p. 191 to 197.

Experiments by Jul. Schreiber, Cand. Med. Foreign. (Königsberg), on the influence of the brain on the body temperature. Seventy experiments on rabbits, all of which underwent injury to the brain after the head had been bored. Only ten survived the experiments for some time. Experiment 8. Rabbit fastened down. Operation performed at 5.37, experiment lasting till 7.30. Animal maintained in position and temperature taken at 11.30 p.m.; kept in position till 7 a.m. on the following day. When unbound it fell down exhausted. Two operations were performed within three hours on the same animal, which was very much collapsed after the second operation, and is stated to have been killed nearly seven hours afterwards. Many animals died during or shortly after the operations, only ten surviving, and of these several died shortly afterwards, so that it was only possible to note the immediate rise of temperature. The results as regarded change of temperature due to the operation were contradictory.—*Pflüger's Archives*, Vol. VIII., p. 576.

Danillo, of St. Petersburg, was induced by Foreign. Professor Munk to undertake experiments in his physiological laboratory.

A dog of five kilos. weight had both halves of the brain opened, and electrodes inserted. Then followed "the crying and shrinking of the animal, convulsions of the ear, eye, jaw, tongue, fore and hind paws of one side, and then the same on the other side of the body." Convulsions outlasted the irritation about two minutes. Ten minutes later fresh stimulation was applied, during which the brain was again cut into, and still the convulsions continued. The wound on the surface of the brain was then covered with German tinder; and the dog left to rest for twenty minutes, until the bleeding had stopped. The blood was then washed from the brain wound, the German tinder removed, and the same places again irritated where the incisions had been made. "Loud howling and crying from the dogs was then heard; but no other motor phenomena occurred." Five minutes later a stronger electric current was applied; and "this stimulation was repeated several times with the same results." "Two hours later the former experiment was repeated, with stimulation, incision, and renewed

stimulation of the same parts at the left side. —*Du Bois-Reymond's Archiv.*, 1884, p. 85. [An anæsthetic was probably employed in some stages of the experiment.]

English. Dr. Ferrier in his lecture on the Brain of Monkeys says: "Experiment XVI. This, though not successful as regards the object intended, yet presents some interesting phenomena. The left occipital lobe was exposed posteriorly, and penetrated at the posterior extremity of the superior occipital fissure by means of hot wires, which were directed with a view to follow the inner aspect of the temporo-sphenoidal lobe. There was no hæmorrhage from the sinus. During the operation, the animal was observed to make sighing respiration. The operation was finished at 4.30 p.m. The animal lay in a state of stupor for more than an hour, only making slight movements when disturbed, and then with its left limbs.

"7 p.m.—The animal lies quiet, but indicates consciousness by grunting discontentedly when moved. Struggles with its limbs, chiefly the left, but occasionally with the right. On testing the cutaneous sensibility with the hot iron reaction was decisive over the whole of the left side, but quite abolished in the right. The animal occasionally opened its right eye, but the left remained permanently closed. The animal passed into a state of coma, and was found dead at 11.30 p.m. . . . The following experiment is a repetition of the last, and was only partially successful."—Croonian Lecture, "Experiments on the Brain of Monkeys," *Philos. Trans.*, 1875, pp. 464-65. [The animal was anæsthetised during the actual operation, but the second paragraph sufficiently indicates the nature of its sufferings from 7 p.m. till death released it.]

M A N G L I N G

(B.)

OF THE SPINE.

Foreign. Dr. Brown-Séquard has described the agony attending section of the posterior columns of the spinal cord, an operation which he has, according to his own account, carried out on many guinea-pigs and rabbits:—"Before the operation in rabbits the most energetic pricking of the skin produces agitation, but no shrieking; after the operation, on the contrary, the least pricking produces shrieking and a much greater agitation. Sometimes the hyperæsthesia (*i.e.*, excessive sensibility) is so considerable that the least pressure upon the skin makes the animal shriek. Whether the operation is performed on the lumbar, the dorsal, or the cervical region, the phenomena are always the same; that is, there is manifest hyperæsthesia in the various parts of the body which receive their nerves from the part of the spinal cord which is behind the section. It has been so in all the animals I have operated upon, and I have already made this experiment upon animals belonging to more than 20 species."—*Lancet*, July 10, 1858, p. 29. quoted in Appendix to Report of Royal Commission, p. 376.

Foreign. M. Chauveau states that his object was:—"To ascertain the excitability of the spinal marrow and the convulsions and pain produced by that excitability." His studies were made chiefly on horses and asses who, he says: "lend themselves marvellously thereto by the large volume of their spinal marrow." M. Chauveau accordingly "consecrated 80 subjects to his purpose." "The animal," he says, "is fixed on a table. An incision is made on its back of from 30 to 35 centimetres (about 14 inches); the vertebræ are opened with the help of a chisel, mallet, and pincers, and the spinal marrow is exposed."

No mention is made of anæsthetics, which of course would nullify the experimenter's object of studying "the excitability of the spinal marrow, and the convulsions *and pain* produced by that excitability." M. Chauveau gives a large number of his "cases." We select the following:—

Case 7. "A vigorous mule. When one prieks the marrow near the line of emergence of the sensitive nerves, the animal manifests the most violent pain."

Case 10. "A small ass, very thin, prieked on the line of emergence—*douleur intense*."

(This animal had been subjected the previous day to a most painful operation—obviously useless, since M. Chauveau's experiment inevitably produced death.)

Case 11. "A vigorous horse. Most evident signs of pain, groans, and makes disorderly movements."

Case 20. Old white horse, "lying on the litter unable to rise, but nevertheless very sensitive." "At whatever point I scratch the posterior cord I provoke signs of the most violent suffering." "The animal agitates himself most violently."—*Journal de la Physiologie*, du Dr. Brown-Séquard. Tome Quatrième. Paris: No. XIII. *De l'Excitabilité de la Moelle Epinière et particulièrement des convulsions et de la douleur produites par la mise en jeu de cette excitabilité*. Par M. A. Chauveau. (Victor Masson et Fils) 1861.

Foreign. Cohnstein. "We can excite the most powerful and rapid change in the circulation by cutting through the spinal marrow above the origin of the splanchnic [nerve]. In an animal thus operated upon, stimulation of the spinal marrow causes the enlarged vessels to contract and the lowered blood pressure to rise to its normal level or even much beyond. . . ."

"Experiment 8.—3/12/85.

At 10 h. 5 m.—Rabbit bound, back upwards.

11 h. 0 m.—Ether narcosis since 20 minutes ago. The vertebral canal opened at the seventh neck vertebra.

11 h. 12 m.—The animal just recovered from the narcosis.

- 11 h. 40 m.—Section of the spinal marrow. The animal has been placed in a heated box some time before.
- 11 h. 48 m.—Body temperature 37.00. Sample of blood taken from a vein of the ear.
- 12 h. 3 m.—Ditto.
- 12 h. 18 m.—Ditto.
- 12 h. 25 m.—35 m.—Intermittent electrical stimulation of the inferior section of the spinal marrow." [This would not cause pain as it was below the section.]
- "12 h. 35 m.—Sample of blood from ear vein. An hour and a-half later the *Art. femoralis* is connected with the Kymograph, and the spinal marrow stimulated as before."

Several experiments similar to the foregoing are described. In one animal, which is said to have recovered from the moderate chloroform narcosis and is able to sit up in its cage, the spinal marrow was afterwards burnt through with red-hot wire. The operations on one rabbit extended over 11 days.—*Pflüger's Archiv.*, Vol. XLII., 1888, pp. 310, *et seq.*

Records of experiments performed by Dr. Goltz and Frensborg. Very soon after the spinal cord has been cut at a certain level old dogs—even strong ones—fall ill with violent feverish symptoms, refuse all nourishment, and die in one or more days. Young dogs, on the contrary, die of the indirect consequences of the operation; they suffer from sores on the hinder part of the body, fall away perceptibly, and die of weakness in a few months at the latest. Cutting the spinal cord is a frightful operation, say the authors, for how many sensitive parts are injured at the same time and put into a state of inflammatory irritation! The consequence of destroying the lumbar portion of the cord is total loss of generative power. The spinal cord of a strong young dog cut, fourteen days later the vertebral column laid bare, the spinal canal trepanned at the level of the lower end of the lumbar cord, the whole right half of the cord cut through with a sharp knife, and the roots of the nerves forming the sacral plexus divided on the same side.

The second wound was allowed to heal like the former one, and the animal died about four weeks after the second operation. "The immediate cause of death," we are told, "remained unknown." The spinal cord of a strong young dog cut on the 28th November; on December 2nd the lumbar portion of the spinal cord was crushed. [This would not cause pain the part being without sensation.] He becomes miserable, gasps, eats nothing, and the fore part of the dog trembles incessantly. Dies on the afternoon of December 3rd. The (cutting) operation was regularly performed under chloroform narcosis (p. 460).—*Pflüger's Archives*, Vol. VIII., pp. 461, 468, 476, 489, 496.

Foreign. Experiment I. Cat placed on Czermak's holder, sciatic laid bare and irritated with du Bois apparatus; an exaggerated secretion of sweat followed.

Experiment IV. Cat: Spinal cord divided between the 8th and 9th dorsal vertebræ. On the next day the sciatic was divided, and a few drops of a solution of muscarin injected subcutaneously at 9 a.m. In Experiment III., we read, "Cat placed in holder and etherised," in the others nothing is said of any anæsthetics.—*Journal of Physiology*, Vol. I., p. 193, &c.

Foreign. Dr. H. G. Beyer, Passed Assistant Surgeon, U.S.N. Honorary Curator, Section Materia Medica, U.S. National Museum, reports experiments with atropine, &c. "The animal having been placed under the influence of morphia is fastened to a dog-holder, tracheotomy is performed and a cannula introduced into the trachea. Through the cannula about half a drachm of a one per cent. solution of curare is injected, after which injection artificial respiration is commenced. The vagi are now found and carefully divided. Cannulas are introduced into the cardiac end of both common carotids, the arterics being clamped on the cardiac sides of the cannulæ. The first two pairs of costal cartilages are now cut away, together with the small piece of sternum which they embrace. Then the two internal mammary arterics are ligatured just as they pass forward from the subclavians towards the breast bone. The whole front and sides of the thorax are now cut away, and the right subclavian artery dissected out and tied, &c."—*International Journal of Medical Science* (1887), pp. 370-1.

Foreign. Experiments on the vaso-motor nerves of the limbs are recorded by Dr. H. P. Bowditch and Dr. J. W. Warren, of Harvard Medical School. The writers say, "After some preliminary experiments on other animals it was decided to employ cats in this research, since adult cats vary less than dogs in size and other physical peculiarities, and are much more vigorous and tenacious of life than rabbits or other animals usually employed in physiological laboratories. The latter point is one of considerable importance in experiments extending over several hours."

The cat was etherised and then its sciatic nerve was divided at its exit from the pelvis—"The wound was now sewed up, the cat allowed to recover from the effects of the ether, and the rest of the experiments postponed for one or more days." "As curare had to be given at intervals of about one hour during the experiments, opportunity was given to study its action upon the circulation in the limbs."—*Journal of Physiology*, Vol. VII., p. 416.

What these experiments on the spinal cord really mean can be gathered from the following statements of Landois and Stirling*:—"After unilateral section of the cord, or even only of the posterior or lateral columns, there is hyperæsthesia (increased sensation) in the same side below the point of section—so that rabbits shriek on the slightest touch. The phenomenon may last for three weeks."

"Lewaschen found that prolonged uninterrupted stimulation of the sciatic nerve of dogs, by means of chemical stimuli (threads dipped in sulphuric acid) caused hypertrophy of the lower limb and foot, together with the formation of aneurismal dilatations upon the blood-vessels."—*Landois and Stirling's Physiology*, 3rd Ed., p. 582.

[Of course, anæsthetics are out of the question in such a prolonged experiment as this.]

* *Text-Book of Human Physiology*, 3rd Ed., p. 646.

M A N G L I N G

(C.)

OF THE STOMACH.

Foreign. Dr. Carl Lüderitz has been studying the movements of the exposed stomach under stimulation.

After going through the literature of his subject, commencing as far back as Haller and Spallanzani, who, more than a century ago, had performed similar experiments, he proceeds to describe his own experiments made on 14 rabbits, 15 cats, and 7 dogs, all fully grown animals. The rabbits were examined in a bath of solution of common salt, either without anæsthetics or curarised and with artificial respiration. Besides the longitudinal section, to open the abdominal cavity, a cross-section was generally made several centimetres long, close to the left side of the arch of the ribs, so that the stomach could be better exposed to view. The cats and dogs were either curarised and artificial respiration resorted to, or anæsthetised by inhalations of chloroform, then the stomach laid bare, either in the salt bath or without. In the latter cases the intestines were protected from chill by being covered with warm salt-water compresses, and the exposed stomach also kept at a nearly normal temperature by constant watering with warm solution of salt. The course of the experiment in the dog, for instance, was as follows:—The dog was bound down on its back to a board, tracheotomy practised, then subcutaneous injections of curare. When dyspnoic symptoms (*i.e.*, approaching suffocation) appeared, artificial respiration was resorted to. As soon as immobility had set in, the animal was placed in the bath, and the abdominal cavity opened. . . .

“The methods of stimulation used on the stomach were mechanical, chemical, and electrical.” In several pages of detailed description of the action of various chemical and mechanical means employed, it is proved that the stomachs of rabbits, cats, and dogs

are all differently affected. "It is quite remarkable, says the experimenter, "that in dogs the reaction is so very different from that of cats."—*Pflüger's Archives*, Vol. XLIX., 1891, p. 162.

Foreign. F. A. Kehrer repeated Oehl's experiments on dogs.

He introduced a cannula filled with tepid water into the bladder, having first injected the whole system with water at blood heat. After the vagus had been found, the abdomen was laid open the whole length of the *linea alba*, and cut across as far as the lumbar vertebræ, then the four pieces of abdominal wall were drawn apart with hooks, and the intestines held back with a cloth, so that the bladder might be freely exposed. After this preparation the actual experiment, which consisted of electrical stimulation of the vagus nerve, commenced.

Experiments on contraction of the bladder caused by irritating sensory nerves have been described by Paul Bert in France, Mosso and Pellacani in Italy, by Sokownin in Russia, Nawrocki and Skabitschewsky in Warsaw. The latter made thirty experiments on cats and rabbits. Each nerve in turn was laid bare and cut. In several cases the spinal cord was divided and electric stimulation applied. Curare alone used in every case. Each experiment lasted about two hours. The three last animals had their nerves squeezed with pincers.

Experiment XVIII. In a large curarised cat all the nerve fibres leading to the inferior mesenteric ganglion, except both hypogastric nerves, were cut, then the right hypogastric nerve was divided, and its central end pinched. This lasted from 12.15 p.m. till one minute past 1.

Experiment XXX. In a curarised cat the lower part of the spinal marrow was destroyed by means of a metallic sound, the left hypogastric nerve cut, and its central end crushed with pincers.

"If, after the abdominal cavity has been opened, the *N. sympathicus* is found, and a glass tube inserted at any point under it and the nerve stimulated, movements of the bladder are produced, and at the same time the animal shows signs of pain, which are never missing."—*Pflüger's Archives*, Vol. XLIX., 1891, p. 141.

English. In the report of the Scientific Grants' Committee of the British Medical Association for 1888, we read, "Dr. Angel Moncy has made experiments on anæsthetised, curarised animals the voluntary muscles were paralysed by means of curare. . . . The movements of the stomach and intestine were watched through a small window in the peritoneum. Artificial respiration was employed in the usual way. . . . The animals used were rabbits, dogs, and cats. . . . The cortex of the brain was removed by slicing and electrical irritation practised on the divided white matter."—*British Medical Journal*, August 4, 1888, p. 264.

English. "I will take one instance from certain experiments performed by Professor Rutherford, and reported in the *British Medical Journal*. I refer to the series of experiments commenced December 14th, 1878. These experiments were 31 in number; no doubt there were hundreds of dogs sacrificed upon other series of experiments, but now I am only referring to one set beginning, as I say, on the 14th December, 1878. There were in this set 31 experiments, but no doubt many more than 31 dogs were sacrificed. All were performed on dogs, and the nature of them was this: The dogs were starved for many hours. They were then fastened down; the abdomen was cut open; the bile duct was dissected out and cut; a glass tube was tied into the bile duct and brought outside the body. The duct leading to the gall-bladder was then closed by a clamp and various drugs were placed into the intestines at its upper part. The result of these experiments was simply nothing at all—I mean it led to no increase of knowledge whatever; and no one can be astonished at that, because these wretched beasts were placed in such circumstances—their condition was so abnormal—that the ordinary and universally recognised effect of well-known drugs was not produced. These experiments were performed without anæsthetics—the animals were experimented upon under the influence of a drug called curare."—*Mr. R. T. Reid's Speech in the House of Commons*, April 4, 1883

Foreign. A Mr. William Halsted, of New York, had already tried circular suture experiments. His report, which is quoted, is as follows:—"Operation on 8th January,

1887." "February 9th, dog is evidently starving to death. Re-open abdomen &c." The operation consists in opening the abdomen, drawing out a portion of intestine, which is sewn into a loop and placed in the abdominal cavity. Some German experiments were not considered successful. This was attributed to the small size of the dogs used, and their consequent weakness and inability to bear the suffering. Morphia [which reduces but does not altogether deaden pain] is stated to have been used in these series of experiments.—*Pflüger's Archives*, Vol. XLVIII., 1890, p. 82.

M A N G L I N G

(D.)

OF THE LIVER.

Foreign. A medical student, named Wilhelm Marcuse performed the following experiment:—

“A healthy frog was stretched on a board, and the stomach being exposed at the level of the liver, to the left of the middle line, by a longitudinal incision about an inch in extent, the liver was extruded by pressure on the sides. This was then cut away to a short stump, the freshly cut surface was dried by cauterisation with a red-hot plate of platinum; and the stump was re-inserted through the incision.”—*Pflüger's Archives*, 1886, p. 444.

MANGLING

(E.)

OF THE KIDNEYS AND THE SPLEEN.

English. Messrs. Phillips and Bradford instituted at the Physiological Laboratory of University College, London, a series of experiments to elucidate, by means of Roy's oncometer, the action of certain diuretics upon the kidneys. Ten animals (rabbits and cats) are scheduled as having been dealt with. We are told that the animal (generally a dog or cat, but sometimes a rabbit) was chloroformed, and a tube inserted into the external jugular or femoral vein. Its windpipe was then opened, curare administered, and artificial respiration kept up. In the earlier experiments curare was not used, simply chloroform, but the results were not so satisfactory. The artery of the neck on one side was exposed and a manometer applied. The kidney was next exposed, carefully dissected from its surroundings, a silver tube fitted into the duct, and the organ placed in the previously warmed oncometer. The experimenters say with regard to certain discrepancies in results: "Possibly it is partly due to this and partly to the fact that different observers have worked on curarised animals, and others on anæsthetised animals, non-curarised, that there is some contradiction" (p. 120). "Finally, one other precaution must be taken, and that is, that enough air be supplied to the animal from the artificial respiration apparatus, as nothing except an overdose of chloroform interferes more with the urinary secretion than a defective amount of air" (p. 123).—*Journ. of Physiol.*, Vol. VIII., pp. 117-132.

"Dr. Roy's invention has been a prolific source of suffering to countless animals. It has been taken up by Drs. Phillips and Bradford who, no longer ago than August, 1887, in the pages of the *Journal of Physiology*, described their experiments with 'Roy's renal plethysmograph' 'on the circulation and secretion of the kidney at the laboratory of University College, London.' Now it

is well known that the kidney is one of the most delicate and sensitive organs in the body. There is a terrible malady known as stone in the kidney, the suffering from which is often most excruciating. I have known patients writhe in agony on the floor of their bed-room when in paroxysms of pain from this cause, which is described in medical works as 'intense'; yet it can be nothing in comparison with the more atrocious sufferings inflicted on these poor animals in Roy's experiments.

"The object of repeating them at University College was to test the physiological action of various drugs on the kidney secretion, and there has not been, nor is it likely there ever will be, the slightest benefit to suffering humanity from these proceedings, which are merely of abstract scientific interest.

"Of course, we are told that all this was done under anæsthetics. But what were they? Curare to keep the animal still and chloroform, 'the effect of which cannot be tested, but which is' not enough to endanger the animal's life, and so spoil the difficult investigation. This, let it always be understood, is the method really followed in the laboratory. The wind-pipe was opened, and the machine for keeping up artificial respiration set going. The drug to be tested was injected into a vein duly dissected out, and the kidney having been previously exposed and placed in the metal box above-mentioned, the influence of the medicine upon the urine was duly noted. These things are done, not in Germany, not in Italy, but in Gower Street, London, by license duly granted by our own Home Secretary!"—*Twelve Years' Trial of the Vivisection Act*, by M.R.C.S., p. 7.

English. "The observations which formed the basis of this communication were made in part during the summer session of last year in conjunction with Professor Cohnheim at the Leipsic Pathological Institute, and in part, during the last autumn and winter in the physiological laboratory of this university" (Cambridge). ". . . The kidney is enclosed in a rigid metal box. . . . The operation is the same as that for nephrotomy, the kidney being reached from the lumbar aspect. It is cleared of all its connections, leaving only intact the structures entering its hilus. It need scarcely be added that the animal, rabbit, cat, or dog, in most cases the latter, was kept fully under the influence of ether, chloroform, or morphia, from the commencement to the

end of the experiment. . . . Arrest for 3 or 4 minutes of the artificial respiration where that is employed and where curare has been previously injected causes a contraction.* . . . Stimulation of the central end of a sensory nerve, *c.g.*, sciatic, brachial plexus, splanchnic, &c., causes a contraction of the renal vessels. . . . As a rule, it is difficult to sever completely all the nerve fibres which accompany the renal vessels. . . . While with some animals section of all the nerve trunks which are visible to the naked eye will suffice for this purpose, with others it is only after the most laborious and minute cleaning of the walls of the vein and artery that vaso-constrictor influences no longer pass to the kidney on stimulation of the splanchnic." *On the Mechanism of the Renal Secretion*, by C. S. Roy, M.D. Reprinted from the *Proceedings of the Cambridge Philosophical Society*, May 23, 1881.

The meaning of the above scientific description is in plain language, as follows:—

"Divested of technicalities, the operations consisted in cutting down through the loins of living dogs and dissecting out their kidneys, but without dividing the veins and arteries by which they were connected to the circulatory system. A kidney-shaped metal box was made to fit the kidneys, which were placed in the box and surrounded with warm oil, the organs being then connected with delicate apparatus and recording instruments."

(Dr. Berdoo says that at the discussion following his address at Cambridge, he made the apologists of Vivisection confess that either chloroform, ether, or narcotics would have vitiated the results of these experiments.) The German account, by Roy's

* "Is there anything to prevent your giving both drugs, or giving them mixed together, so as to stop the pain by the chloroform, and the nervous movement by curare?—Yes, there is, and it is this:—In very many of those experiments you want to ascertain what is termed the reflex action: that is to say, that an impression is made upon a nerve and goes up to the cord and is transmitted down. Now chloroform acts upon the reflex centres and abolishes their influence completely: so that if you give the curare, which paralyses the ends of the motor nerves, and give the chloroform, which paralyses the reflex centres, you deprive yourself of the possibility in many instances of making satisfactory experiments."—*Dr. Lauder Brunton's evidence before the Roy. Com. Q. 5,743.*

coadjutor, Prof. Cohnheim, says:—"The great majority of our experiments were made on dogs under curare with artificial respiration, but several were under morphia. With rabbits there is no particular difficulty in dispensing with all narcotics."—*Virchow's Archiv.*, Vol. 92, Part 3.

Foreign. Dr. Walter Mendelsohn, of New York, made experiments in the Pathological Institute at Leipzig, under the direction of Professors Cohnheim and Ludwig, to ascertain the functions of the kidneys in fever. The animals used were curarised dogs. Injections were made of pus, to produce fever; where this did not succeed, the animals were placed in heated boxes. The blood pressure in the kidneys was observed by means of an oncometer and oncograph. If the circulation in the kidney had to be measured and examined during a period of three or four hours by means of the oncometer or oncograph it was absolutely necessary that the animal under observation (*Versuchsthier*) should be kept quiet during the whole time; it is a matter of indifference (we are told) whether this is done by deep narcosis (morphia, ethloral, or chloroform) or by paralysis of the muscles by curare. In the experiment of May 12th, 1882, it is distinctly stated that the dog had only a small dose of morphia, scarcely sufficient to keep the dog asleep, and certainly not sufficient to plunge it into a deep narcosis.—*Virchow's Archives*, Vol. 100, p. 274.

English. Dr. Bradford, of University College, London, has mutilated the kidneys of dogs. Firstly, he removed a portion of one kidney. At intervals varying from a fortnight to six weeks the entire other kidney was also removed, thus leaving the animal with only a portion of kidney. After the second operation the animals became emaciated and died at a period varying according to the size of the remnant of kidney remaining. Sometimes the dogs lived a fortnight, sometimes six weeks.—See *Proceedings of Physiological Society*, March 21, 1891, in the *Journal of Physiology*, Vol. XII., No. 3, p. xviii., Aug., 1891. [Dr. Bradford states that the animals were anæsthetised with chloroform and morphia while the operations were performed, but there is no mention of the anæsthetics in the original report, and if used in all cases could have saved the animals a portion only of their sufferings, and did not prevent their emaciation and death.]

MANGLING

(F.)

OF THE THYROID GLAND.

English. "One [pathological] experiment was made on a donkey, the thyroid gland was excised in August, 1885, and the animal died in 205 days, or about seven months. The chief symptoms for two months were emaciation and weakness; the mental hebetude, if any, was difficult to gauge; the temperature of its body was but slightly lowered. In March, 1886, when the weather became severely cold, nervous symptoms suddenly supervened, and tremors were observed for three days, chiefly in the muscles of the head and neck. On the fourth day, these were complicated by constant twitching; the animal became so weak as to be unable to stand; and the body temperature became markedly lowered. Later still, muscular rigidity was observed, and also the paralysis increased, especially in the jaw. On the fifth day of the cold weather the donkey became much worse and died in the morning." Sheep, pigs and monkeys were also experimented on in a similar way. "The whole subject, however, required further investigation."—*Brown Lectures, by Prof. Horsley, Lancet*, Dec. 18, 1886. [If any anæsthetic were administered in this case, it could only have saved the animal a small part of its suffering.]

Foreign. Ughetti extirpated the thyroid gland of dogs. Some lived a few days after the operation, and convulsions might occur. He administered cocaine to sound dogs and to those without thyroid glands for the purpose of inducing convulsions.—*Centralblatt f. d. Med. Wissenschaften*, July 18, 1891, No. 29, p. 543.

Foreign. Schiff has transplanted the thyroid gland of large dogs into the abdomen of smaller dogs and after two or three weeks extirpated the animal's own glands.—*Du Bois Reymond's Archives*, 1890, p. 528.

Foreign. Dr. Leo Breisacher, of Detroit, U.S.A., made 30 extirpations, of which 25 were total. Nine dogs only lived. Schiff had used 52 dogs for the same purpose. The following is one of Dr. Breisacher's experiments :

"Experiment XV.—A young mongrel dog, weight 11·5 kilos. Both thyroid glands extirpated after a diet of eggs and milk for four days. The dog was healthy for four days. . . . On the fifth day the dog took its usual quantity of milk, but whined now and again. On the ninth day the dog refused to come out of its cage, and would not touch the milk. The animal howled often, and kept its left leg closely pressed to its side. It was taken out of its cage to be examined. In doing so I took hold of its hind leg rather sharply, which caused it to fall down with a loud cry, and it had slight convulsions lasting some minutes. It was found that matter had formed. When this was let out the dog seemed better. . . . On the eighth day the dog refused its milk, and held its leg convulsively pressed to its body at intervals. . . . On the twenty-second day the dog was let loose in the yard. Suddenly its hind legs became stiff, and it cried out as if in great pain. During the next three days these symptoms were of daily occurrence as soon as the dog had run about a little. On the twenty-sixth day the fore-legs were also stiff, so that it could only move with difficulty. . . . On the thirty-second day, after it had been fed on meat broth, on being turned out of the cage it sprang about in a lively manner for eight minutes, and then suddenly was seized with convulsions, which seemed to cause great pain. . . . From the thirty-fourth to the forty-first day it was fed exclusively on raw meat, and from that day the animal could no longer move on account of the stiffness of its muscles. On the forty-second day the dog was found dead."—*Du Bois Reymond's Archives*, 1890, Dec. 24, p. 517.

Foreign and English. "A very thorough series of experiments was carried out by Ewald, Fano, Fuhr, Herzen, Carle, and Weil, and a few observations were made by Breisacher. In these experiments not merely the special

glandular nerves derived from the sympathetic observed by Liebrecht and others, but also the trunks of the laryngeal nerves and even the vago-sympathetic trunk were subjected to every conceivable form of irritation, by extensive traumatism, septic inflammation, even by direct inoculation of septic microbes, chemical irritation, electrical excitation—all producing intensely the conditions supposed by Munk to cause the cachexia thyroidec-tomica, but with absolutely no result. Finally, other observers have examined the condition of the nerves after thyroidectomy, and have found them uninjured. This has been done by Schiff, Fuhr, von Eisselsberg, Ewald, Loeb, and myself.”—Remarks on Function of Thyroid Gland, by Victor Horsley, F.R.S., *Brit. Med. Journal*, Jan. 30, 1892, p. 215. [Mr. Horsley stated in the *Times* that he used an anæsthetic in the actual operation, but no mention was made of this in the paper from which the quotation is made.]

M A N G L I N G

(G.)

OF THE HEART AND BLOOD-VESSELS.

English. Under the title "Electrical Stimulation of the Heart in Man," Dr. McWilliam published a paper giving results of experiments made in the Physiological Laboratory of his University. He said:—

"The application of strong galvanic and faradaic currents to the ventricles is attended with disastrous results; an immediate abolition of the normal heat, and the occurrence of inco-ordinated arhythmic contractions of the ventricular muscle (fibrillar contractions or heart delirium), attended by a great and rapid fall of blood pressure, and in the higher mammals (the dog, at least) by speedy death. The phenomenon in question is one that occurs in more or less extreme form in every mammal examined, and indeed in birds as well. I have myself observed it in the hearts of the dog, cat, rabbit, hedgehog, rat, mouse, guinea-pig, hen, pigeon, and blackbird." As to the nature of his experiments, he added: "In order to elucidate more fully the influence of a series of induction shocks upon the inhibited heart, I have frequently (on the dog, cat, and rabbit) performed such experiments as the following:—The animal being chloroformed" . . . "the thorax and pericardial sac were laid open; artificial respiration was kept up through a cannula introduced into the trachea (windpipe). The heart was inhibited by stimulation of the vagus nerve in the neck, and then a periodic series of induction shocks was applied to the apex of the ventricles."—*British Medical Journal*, Feb. 16, 1889.

English. A number of experiments were performed by Mr. H. D. Rolleston, B.A., of St. John's College, upon the blood pressure within the hearts of dogs and rabbits. Mr. Rolleston proceeded to open "a window" in the chest of the anæsthetised and *curarised* dog that he might insert a glass tube into its heart. We are told that he followed a method invented by an Italian named Magini. The object of inserting a glass tube into the cavity of the heart was to ascertain what was the endocardial pressure. Mr. Rolleston says, p. 260:—"My results are very distinctly opposed to those obtained by Marey and Chauveau, which are, I believe, those usually accepted by physiologists at the present time.—*See Journ. of Physiol.*, Vol. VIII., p. 235.

English. Dr. Berry Haycroft has, with the assistance of Dr. Robert Edie, also of the Physiological Department of the University of Edinburgh, opened the abdominal cavity of rabbits under ether and curare, cut away the diaphragm, lifted the heart from the lungs by means of forceps, then let it drop back again. After describing the whole of his experiments and their results, he adds: "The experiments for clinical purposes will be of little utility."—*Journal of Physiology*, Vol. XII., Nos. 5-6, December, 1891, p. 426.

Foreign. "In large mammals, such as the horse, Chauveau and Marey (1861) determined the duration of events that occur within the heart, and also the endocardial pressure by means of a *cardiac sound*. Small elastic bags attached to tubes were introduced through the jugular vein into the right auricle and ventricle. Each of these tubes was connected with a registering tambour, and simultaneous tracings of the variations of pressure within the cavities of the heart were obtained by causing the writing points of the levers of the tambours to write upon a revolving cylinder."—*Text-Book of Human Physiology*. By Dr. L. Landois, with additions by William Stirling, M.D., London, 1888, p. 67.

Foreign. *Ligature of the Coronary Arteries.*—"Séc and others have ligatured the coronary arteries in dogs, and found that after two minutes the cardiac contractions gave place to twitchings of the muscular fibres, and ultimately the heart ceased to beat. . . . If the coronary arteries be compressed or tied in a rabbit in the angle between the bulbus aortæ and the ventricle, the heart's action is soon weakened, owing to the sudden anæmia, and to the retention of the decomposition products of the metabolism in the heart-muscle. Ligature of one artery first affects the corresponding ventricle, then the other ventricle, and last of all, the auricles. Hence, compression of the left coronary artery (with simultaneous artificial respiration in a curarised animal) causes slowing of the contractions. . . ."—*Text-Book of Human Physiology*. By Dr. L. Landois, with additions by William Stirling, M.D., London, 1888, pp. 56-57.

M A N G L I N G

(H.)

OF THE BONES.

Foreign. At the Berlin Physiological Society, Dr. Goldscheider gave an account of some experiments he had made. He wished to test the sensitiveness of the surfaces of joints. For this purpose he must, of course, have opened into the joints. Rabbits were used in the experiments, and the joints selected were those of the legs. But not only were the joints opened, and the surfaces of the bones exposed, but the bones themselves were sawn open. [Of course, anæsthetics would be out of the question when pain-testing was the essence of the experiment.] The conclusion he arrived at was that the marrow was more sensitive than the hard part of the bone, and the growing part more than the formed.—*Nature*, April 3, 1890, p. 528.

Foreign. In Paris Dr. Simon Duplay, Professor of Surgery, and Dr. Maurice Cazin, produced arthritis in dogs, by applying the thermocautery to the joint cavity, or by injecting iodine tincture, or nitrate of silver, into the knee cavity. In one dog they twisted the leg to produce a sprain and tore the ligaments. A month after they tried "fresh acts of violence," which were renewed frequently.—*Archives Générales de Médecine*, Paris, January, 1891, p. 5, etc.

English. "The best method is to pass a needle into the knee-joint of a rabbit in such a way that it penetrates into the tibia. A few days after sections are made of the fresh cartilage, and stained in gold. . . . Germination of the cells of bone may be induced in the long bones of mammalia by passing a red-hot needle as deeply as possible into a bone previously freed of the soft parts covering it, and then cauterising the hole with a pointed stick of nitrate of silver, or by violent fracture.

After a week or more the bone is excised."—*Appendix to Report of Royal Commission on Vivisection*, p. 381.

Foreign and English. "The micro-organisms (of *micrococcus pyogenes aureus*) injected into the pleura or knee of a rabbit produce, as a rule, a fatal result on the following day; but if it survives longer it eventually dies of severe phlegmon. If injected into the knee of a dog, suppuration occurs, followed by disintegration of the joint. . . .

"They occur in the pus of boils, and in the abscesses of pyæmia, puerperal fever, and acute osteomyelitis. Injected into the peritoneal cavity of animals they set up peritonitis, and introduced into the jugular vein they produce septicæmia and death. When a small quantity of a cultivation was introduced into the jugular vein, after *previous fracture or contusion* of the bones of the leg, the animal died in about ten days, and abscesses were found in and around the bones, and in some cases in the lungs and kidneys."—*Manual of Bacteriology*, by E. M. Crookshank, London, 1890, pp. 246-7.

Foreign. Experiment I. Large watch-dog. "Extended on vivisection table on its belly, the four limbs and head fastened, but not too tightly, so that the animal may be able to execute defensive movements like a person who receives a blow accidentally. With a large empty stone bottle I strike a dozen violent blows with all my strength on the thighs. The animal, by its violent cries, indicates that the bruise is vividly felt." Experiment VII. Large female dog. "We proceed this time without anæsthetics. The animal is fastened on the vivisection table. I dislocate successively both her shoulders. The animal, which appears to suffer greatly, is kept in a condition of dislocation for about half-an-hour. It struggles violently in its bonds. The autopsy showed that there had been a tearing away of the lesser tuberosities (*petites tuberosités*) and of all the adjoining skeleton, with abundant flow of blood and serum." VIII. Poodle. Chloroform and morphia given the second day before the operation. "Replaced on the table without chloral. I dislocate his two shoulders. The animal utters screams. I keep him 20 minutes with his two shoulders dislocated and the elbows tied together behind his back."—Dr. Castex, in the *Archivé Générales de Médecine*, January, 1892, pp. 9 to 22.

M A N G L I N G

(I.)

BY CRUSHING WITH "TORMENTATORE."

Foreign. The fifteenth chapter of Professor Mantegazza's work is in substance that which had previously appeared in the pamphlet *Dell' Azione del Dolore*, and concerns "various methods for studying the Influence of Pain on the Mechanism of Respiration." There were two things to be determined: first, the mechanical influence of pain on the rapidity of breathing; second, the chemical influence of pain on the breath itself. He began with twelve experiments on guinea-pigs—some strong, some "very thin"—two of them with young. "One of the guinea-pigs, "in an advanced state of pregnancy," after ten minutes of "most atrocious pain" became useless for experiment because of convulsions of every muscle. Next came the experiments on the amount of carbonic acid gas in the breath of a creature under pain, and after a series of quotations from English and French unsatisfactory authorities, the Professor congratulates himself: "I had therefore before me a little explored region of pathology; it had all the attractions (*le seduzioni*) and all the difficulties of the unknown" (p. 93). The problem was—to create intense pain and at the same time to keep the creature motionless in an attitude which would not (like lying on its back) interfere with respiration. The ingenious Professor hit on two ways to accomplish this double purpose, "either by exasperating the pain so that its influence overcame the action of the muscles of motion; or by planting sharp and numerous nails through the soles of the feet in such a way as to render the animal nearly motionless, because in every movement it would have felt more acutely its torment" (p. 95). For the former purpose he caused a machine to be constructed, a drawing of which is inserted in the book. In the centre is a large cylindrical glass box or bottle, in which lies a rabbit. Through

the cover descends and moves freely a handle terminating in iron pincers and claws—so arranged that the presiding physiologist may grip at pleasure any part of the animal's body and lacerate or crush it at his discretion. "Thus," he says, "I can take an ear, a paw, or a piece of skin of the animal, and by turning the handle squeeze it beneath the teeth of the pincers; I can lift the animal by the suffering part, I can tear it or crush it in all sorts of ways." Figure 2 represents this "tormentor" isolated from the rest of the apparatus (p. 99). The breath of the animals passes through two tubes out of the bottle into suitable vessels. Then follow the details of twenty-eight experiments. Many of them, he says, occupied two days, all of them one day at least, the animals being put into the apparatus for an hour or two, then taken out to rest and put in again. The Professor prefaces what is to follow by this remark:—

"These my experiments were conducted WITH MUCH DELIGHT AND EXTREME PATIENCE for the space of a year." (*"Queste mie esperienze furono condotte con molto amore e pazienza moltissima per lo spazio di un anno."*)—See *Fisiologia del Dolore*, p. 101.

MANGLING

(J.)

BY LARDING FEET WITH NAILS.

Foreign. One experiment is on a guinea-pig nursing its young; another on a dove enclosed in the machine and tormented for nearly two hours, then taken out, and after some respite, put back again for another hour and fifty-five minutes, with "many nails in its feet and wings," and again subjected to the action of the "tormentatore" which "leaves it often *accasciata* (prostrated) with pain." A rabbit, after two hours' torture and a few moments' rest, has four long nails stuck into its extremities, and the Professor "succeeds in producing a pain much more intense than in the eleventh experiment" (p. 106). Two white rats, after two hours of the machine, are "larded with long thin nails in their limbs." They "suffer horribly, and, shut up in the machine for two hours more, they rush against each other, and not having the strength to bite, remain interlaced with mouths open, screaming and groaning" (p. 107). A rabbit and a guinea-pig which had survived previous experiments, and had in consequence suppuration and inflammation of the extremities, were subjected to two hours' torment, then the "usual nails" ("*soliti chiodi*") were inserted. Another rabbit was placed for six hours in the machine, and next day larded with nails and shut in the machine for six hours more. Another rabbit was "*imbottito di chiodi*" ("quilted with nails"). The result of the whole twenty-eight experiments is a synoptical table of the water and carbonic acid produced under the various degrees of "little pain," "much pain," "cruel pain," and "atrocious pain" respectively.—*Fisiologia del Dolore* di Paolo Mantegazza, Florence, *Paggi*, 1880 (p. 115).

M A N G L I N G

(K.)

BY DISSECTING OUT NERVES AND
IRRITATING WITH ELECTRICITY.

Foreign. The *British Medical Journal Supplement*, 1891, refers to researches of Nawrocki and Przybylski on the "Pupil Dilating Fibres of the Cat," published in the *Archiv. f. d. gesam. Physiologie* (Vol. L., Haft 5 and 6, p. 234). These authors give an account of what has been done before them by Parfour du Petit and Budge. . . . Here are some of the results:—

"The pupil dilating fibres pass downwards from the brain into the cord, which they leave by the anterior roots of the eighth cervical and first and second dorsal nerves." [Every one of these nerves, and the spinal cord itself, have been laid bare, cut and stimulated.] After describing nerve by nerve the path of the fibres, stimulation of which causes the pupils to dilate, they go on to mention their relation to what is called the Gasserian ganglion. Cutting the trigeminus nerve in front of this ganglion, they say, "does away with the dilatation that accompanies stimulation of the cervical sympathetic." The next thing that was done was to remove the ganglion altogether, and then stimulate the sympathetic nerve in the neck. This caused the pupil to dilate. Then they cut out the superior cervical ganglion of the sympathetic, and then stimulated and found it was still possible to cause pupil dilatation through the spinal cord. The later experimenters differed from Budge as to the existence of a pupil dilating "centre" in the spinal cord itself. They maintain that no such centre exists, and endeavoured to prove their contention by cutting through the spinal cords of cats and stimulating their sciatic nerves.—*British Medical Journal*, October 24th, 1891, p. 134.

The following are two out of the long list of forty experiments from the original in *Pflüger's Archives* :—

“Experiment I. A large curarised cat. A small hole was bored in the occipital bone beneath the occipital protuberance, and a second hole in the atlas. Two needles flattened at the ends were introduced into the *medulla oblongata* and connected with the induction apparatus. During the stimulation both pupils dilated. Section of the right sympathetic nerve caused contraction of the corresponding pupil. During the subsequent stimulation of the *medulla oblongata* the left pupil was widely dilated, the right but little.”

* * * * *

“Experiment X. A large curarised cat. Both sympathetic nerves in the neck tied and divided. Then the skull broken open and the brain lifted up to allow all three branches of the trigeminus to be cut in front of the Gasserian ganglion. (That there had been complete division of the three branches of the trigeminus was made certain afterwards by the *post mortem*.) The right pupil dilated, but only slightly (probably in consequence of the great loss of blood and the consequent anæmia of the right bulbus). Stimulation of the right sympathetic nerve in the neck had no influence over the size of the right pupil; stimulation of the left sympathetic nerve in the neck caused the left pupil to dilate fully.”—*Pflüger's Archives*, Vol. L., p. 234.

And so on through the list of 40 experiments on the same lines; curarised cats and chloroformed cats the victims; nerves cut, ganglia extracted and exposed; spine opened, spinal marrow divided, and nerves stimulated.

“The frogs—curarised weakly or not at all—are prepared in the following manner :—The animal is placed on its back on a piece of cork fastened by a needle through the end of the nose, the lower jaw drawn back and also fastened with pins. Then the mucous membrane is cut away in a circular form, the right eyeball, which protrudes into the back of the throat is seized, and the copiously bleeding vessels are tied. Next a bent hook is introduced into the cavity of the eye, drawing out the muscles and optic nerves, which are also secured by a ligature. The eyeball is then split with a needle near the point where the optic nerve enters, a circular piece cut away from the sclerotic, and the crystalline lens, &c., removed from the eyeball. The frog is then brought on to the glass plate, and a glass tube fixed into the empty eye cavity. . . .

"If the frog is not curarised the sciatic and crural nerves are cut through. It is, however, sufficient to fasten the head completely to the cork in order to immobilise the animal (p. 105).

"I may remark that my experiments lasted during a whole year, and I have, therefore, tried frogs at all seasons. . . . The dissection of the trigeminus nerve for the purposes of stimulation is surrounded by great difficulties, and I have only succeeded in applying the electrodes to the middle branch."—*Dr. Otto Drasch, in "Du Bois Reymond's Archives," 1889.*

We are told in a note what Professor Brücke says with reference to section of the trigeminus :—"The first sign that the trigeminus is divided is a loud piercing cry from the animal. Rabbits we know"—he adds—"are not very sensitive; all sorts of things may be done to them without making them utter a cry; but in this operation, if it succeeds, they invariably send forth a prolonged shriek."—*Lectures on Physiology, Vol. II., p. 76.*

English. The *Croonian Lecture* to the Royal Society, 1891, by Professor Victor Horsley and Mr. Gotch contains references to hundreds of experiments consisting in exposing the brains of etherised cats or monkeys for excitation by electrical, chemical or mechanical stimuli. At first the animals were deeply anæsthetised, but were subsequently allowed to recover to "slight anæsthesia" (p. 299). The great sciatic nerve was usually selected and was exposed in the thigh for 6 cent. of its length. It was then divided near the knee, and its central end ligatured, &c. —*Croonian Lecture, 1891, p. 283.*

SECOND CIRCLE.

ARTIFICIAL DISEASE.

CREATION OF DISEASE

(A.)

BY TREPANNING AND SQUIRTING VIRUS INTO THE BRAIN.

English. “The first object of the experiments was to test M. Pasteur’s method of transmitting rabies by inoculation, and to compare its effects with those of rabbits due to the bites of dogs found rabid in the streets. Through the kindness of M. Pasteur, two rabbits inoculated by him were placed at the disposal of the committee on the 5th May, 1886, and were conveyed within twenty-four hours safely to the Brown Institution, where the experiments were carried out by Mr. Horsley.

“In these two rabbits the first symptoms of rabies appeared on the 11th and 12th of May, and the disease followed exactly the course described by M. Pasteur.

“At first the animals appeared dull, but continued to take food readily until symptoms of paralysis appeared. The first of these symptoms was commencing paralysis of motion of the hind legs, not accompanied by any loss of sensibility. The paralysis soon extended to the muscles of the fore-legs and later to those of the head, and the animals died comatose.

“After *post mortem* examination, portions of the spinal cord of each of these rabbits were crushed, according to M. Pasteur’s method, in sterilised broth, and the liquid so obtained was injected beneath the *dura mater* into four rabbits and the same number of dogs, all being first rendered insensible with chloroform or ether. . . . [Mr. Horsley here remarks in a foot-note, “All the experiments performed in this inquiry were thus made painless.”]

“Of the four dogs inoculated, the first showed on the eighth day after inoculation an alteration in the voice and commencing excitement; on the following day the excitement became excessive, and the bark was quite characteristic; on the eleventh day the dog was

aggressive, notwithstanding slight paralysis of the legs; on the twelfth day the paralysis had increased, and on the next day there was complete paralysis and coma, and death occurred on the fifth day after the onset of the symptoms.

"The second dog showed the first symptom on the ninth day after inoculation, when it was very dull and partially paralysed; its bark was characteristic. Next day the paralysis was almost complete, and on the twelfth day the animal died. This was therefore a case of the rapid paralytic form; whilst in the first dog the disease was of the ordinary furious form of rabies terminating in paralysis.

"The third dog showed the first symptom on the ninth day after inoculation, and from that time became gradually paralysed, and died on the sixteenth day.

"The fourth dog showed the first symptom in from eight to nine days after inoculation, and during the first day was extremely aggressive; on the two following days the characteristic bark was observed; and on the twelfth day there was paralysis of the hind legs; it died on the thirteenth day. Thus the furious form and the paralytic or dumb form of rabies were represented in equal numbers, whereas, in the usual mode of infection by biting, the former is more prevalent. . . . "

"For the purpose of exact comparison of the disease just described with that produced when rabies is communicated to the rabbit in the ordinary way, some rabbits previously narcotised with ether were caused to be bitten by rabid dogs of the streets, or were inoculated by trephining with material obtained from the spinal cord of dogs or other animals which had died of rabies, and in one instance from that of a man who had died with hydrophobia.

"Four series of experiments of observations in which rabbits were bitten by rabid dogs from the streets were made. In one of them the dog by which the rabbit was bitten exhibited the dumb form, in others the furious form, of the disease. In each series, excepting the first, a large proportion of the rabbits died; the symptoms presenting themselves in these cases were identical with those observed in the rabbits inoculated from M. Pasteur's virus, but the duration of the symptoms was usually longer. As has been stated, rabbits inoculated by M. Pasteur's virus rarely show symptoms during more than three days before death, whereas the rabbits bitten by rabid dogs from the streets often live for a week after the appearance of the first symptoms. . . . "

"To test them" [*i.e.*, Pasteur's methods of inoculation], "six dogs were protected by injecting subcutaneously the emulsions of spinal cords of rabbits which had died of rabies; beginning with that of a cord which had been dried for fourteen days, and, on each following day, using that of a cord which had been dried for one day less, till at last that from a fresh cord was used. None of these dogs suffered from the injections; and when they were completed, the six dogs thus 'protected' and two others unprotected, and some rabbits unprotected, were made insensible with ether, and were then bitten by rabid dogs, or by a rabid cat, on an exposed part.

"A 'protected' dog, No. 1, was bitten on July 8th, 1886, by a dog which was paralytically rabid. It remains perfectly well. An 'unprotected' dog, No. 1, was bitten a few minutes afterwards by the same rabid dog, and died paralytically rabid. A 'protected' dog, No. 2, was bitten on November 6th, 1886, by a dog which was furiously rabid; it remains well. At the same time, four 'unprotected' rabbits were bitten by the same rabid dog, and of these two died of rabies in the usual form (*i.e.*, 50 per cent. of animals bitten).

"The same results followed with the 'protected' dog, No. 3, and the 'unprotected' rabbits, bitten at the same time. The dog still lives, the rabbits died of rabies.

"The 'protected' dogs, Nos. 4 and 5, were bitten on January 20th, 1887, by a furiously rabid dog; and on the same day the 'unprotected' dog, No. 2, and three 'unprotected' rabbits were bitten by the same dog. The protected dogs remain well; the unprotected dog and two rabbits died with rabies (*i.e.*, 75 per cent. of the animals bitten).

"The 'protected' dog, No. 6, was bitten on three different occasions by a furiously rabid cat on September 7th, 1886; by a furiously rabid dog on October 7th, 1886; and by another furiously rabid dog on November 6th, 1886. It died ten weeks after being bitten for the third time, but not of rabies. It had been suffering with diffuse eczema during the whole of the time that it was under observation, and it died of this. At the *post mortem* examination no indication of rabies was found; and two rabbits, inoculated by trephining with the crushed spinal cord, showed no sign of rabies, either during life or, when they were killed several months afterwards, in any appearance after death. It was thus made certain that the dog was not rabid." . . .

Coincidentally with these experiments, some were made by Mr. Dowdeswell for the purpose of ascertaining whether any drugs can protect an animal from rabies. Their result is recorded in a paper read before the Royal Society, and may be summed up in the statement that rabies can neither be prevented nor influenced in its course, unless it be for the worse, by any of the drugs that were employed, including allyl alcohol, atropine, benzoate of soda, chloral, cocaine, cnrare, iodine (dissolved in iodide of potassium), mercuric perchloride, quinine, salol, strychnine, nrethan.—*Report of the Committee appointed by the Local Government Board to inquire into M. Pasteur's Treatment of Hydrophobia, June, 1887.*

Foreign. A paper on "An experimental Research into Rabies," by Harold C. Ernst, A.M., M.D., Harv., Demonstrator of Bacteriology in the Medical School of Harvard University, contains an account of a repetition of Pasteur's experiments with rabies.

The author records that on the 2nd of July, 1886, he "received from Dr. Hamilton Osgood two rabbits, one of which had been inoculated upon the 19th or 20th of June, in Pastenr's laboratory, and had died on the 28th of Jnne, and been kept upon ice since that time; the second of which was inoclated on the 21st of Jnne in Pastenr's laboratory by Pastenr himself, and, alive when received, died on the night of July 4th." With matter from the spinal cord of these Dr. Ernst inoculated by trephining thirty-two rabbits, all of which subsequently died of rabies. The symptoms described are, first unsteadiness of gait, next stiffness or lameness, or paralysis, then, "occasionally a decided change in the character of the animal; from being lively and affectionate it becomes dull and sluggish, and even fierce—if such a term may be applied to a rabbit; in the latter case it will jnmp at and bite objects held towards it, and may even growl and spit at them, showing every evidence of a desire to do harm. . . . The power of deglutition is lost in twenty-four or more hours from the first appearance of any symptoms—and it was at one time supposed that death was cansed by starvation. This can hardly be the case, however, inasmuch as the stomach is always full of partially digested food, etc. . . . Just before death there seems to be a revival of the powers—as manifested by a renewal of struggles"—to walk about,

etc. Eight other rabbits were inoculated, but owing to various causes no result was produced. Ten more were used for "control" experiments. Twelve guinea-pigs, nine dogs, and numerous rabbits were used for further experiments. In Table IV. (p. 329), an inoculated rabbit is declared to have been "savage" from October 13 to 23.—*International Journal of Medical Sciences*, April, 1887, pp. 321-342.

Foreign. "It is one of these dogs, in the paroxysm of rabies which M. Pasteur showed us, observing, 'He will die to-morrow.' The animal looked at him, its body gathered up, the tail dropped, the mouth foaming, ready to bite. M. Pasteur having kicked the wires of the cage, the animal dashed at him. It bit the bars, which became red with the bloody saliva. Then with its jaws bleeding, it turned tearing the straw of its litter, back into its kennel which it had gnawed the preceding night. From time to time it uttered a piercing and plaintive cry.

"Beside the dogs which he kept underground in the Rue d'Ulm, the illustrious *savant* possesses a kennel in the Rue Vauquelin, and another at Montmartre. It is by hundreds that must be reckoned the animals sacrificed in his researches."—*L'Illustration*, May 31, 1884.

To understand the condition of the "innumerable" dogs, which M. Pasteur boasted at Copenhagen that he had then already inoculated, it is desirable to recall the description given of the disease of natural Rabies by the humane and experienced veterinary surgeon, Mayhew.

"The entire glandular system seems to be in the highest degree inflamed. Beside this, the brain, the organs of deglutition, digestion, and occasionally of respiration, are acutely involved. *The entire animal is inflamed. . . .*" Most frequently the eyes, which at first glow like live coals, turn green, ulcerate, and perish, the rabid dog before it dies becoming absolutely sightless.

The effect of the artificially induced rabies by M. Pasteur's process of trepanning and squirting virus into the brain, is to produce an aggravated form of the malady (if such a thing be possible). An article in the *Fortnightly Review* describes it thus:—

"Pasteur holds that to have vaccines always ready to hand of the requisite degrees of activity, there must be a constant trepan-

ning of the animals whose living brains he wants for a virus-garden. The trepanned and inoculated rabbit soon gets numb and paralysed. The guinea-pig becomes exasperated by its torture, and wants to bite everyone and everything near it. In the case of the dog mental anguish is the first symptom. The poor brute appears conscious that it must soon be dangerous, and as if wanting to beg pardon beforehand. Its efforts to propitiate indulgence for the state which it feels is coming on are heartrending to anyone who has any healthy sensibility. Veterinaries assure me that natural rabies, or rabies caused by bites, is mild compared to rabies induced through virus being let in on the brain; and I believe them, since I saw how quietly some of the wolf-bitten Russians died. The delirious period is fraught with mental and physical torture to the trepanned dog.”—*Fortnightly Review*, July, 1886.

English. “Dr. Hime, the Medical Officer of Health for Bradford, who had enjoyed an unusually good opportunity of studying M. Pasteur’s method in Paris, inoculated a rabbit by introducing a small portion of the medulla of the dog within the cranium. The rabbit developed the symptoms which M. Pasteur considers to be characteristic with rabies in that animal.”—*British Medical Journal*, November 6, 1886, p. 872. Granting that Pasteur’s method of inoculating the animal includes chloroforming it during the trephining process, the after consequences of the operation could not be in the least mitigated by that fact.

CREATION OF DISEASE

(B.)

BY ORDINARY INOCULATION (OF LEPROSY, CANCER, &c.).

Foreign. "Dr. Hanan, of Zurich, has successfully trans-

ferred [cancer] from a rat with such a growth on the vulva to a series of other rats; and Wehr has transferred carcinoma from one dog into the subcutaneous tissue of the abdomen of another. We are able to append a figure from a photograph of one of the infected rats which he kindly left with us."—*British Medical Journal*, March 14, 1891, p. 567.

English. Mr. Watson Cheyne delivered a series of lectures "On the Pathology of Tuberculous Diseases of Bones and Joints," at the Royal College of Surgeons of England, which were reported in the *British Medical Journal*. He records a number of experiments which he performed upon animals with the view of setting up tuberculosis. In the lecture reported April 11, 1891, p. 791, he says, "I have on many occasions inoculated portions of synovial membrane and pus from strumous joints subcutaneously, or into the anterior chamber of the eye, in rabbits and guinea-pigs, and have invariably produced typical tuberculosis by this means. The same has been the experience of a number of other workers." He goes on to say how tubercular disease has been induced in animals by the introduction of the injected material into their bones and joints. For this purpose the expectoration of consumptive patients has been used, matter from diseased joints and from abscesses. He says, "Such cultivations injected into the joints of rabbits and goats set up typical strumous disease of the joints," and so on. In one of his experiments he says, "A guinea-pig was inoculated subcutaneously with tuberculous sputum, and on the same day under chloroform, both knee-joints were contused" (*i.e.*, beaten

and bruised with a mallet or hammer). In the experiments on rabbits, tuberculous expectoration was injected into the knee-joints. In one case the knee became swollen, an abscess formed, the animal was very lame, and as it was suffering from diarrhœa it was killed. It lived 22 days after the experiment began. In two other rabbits holes were drilled into their leg-bones and the matter injected. Another experiment consisted in boring with a bradawl into one of the leg-bones of a rabbit for a similar purpose. Similar experiments were performed on four guinea-pigs. The animals lived with diseased joints and bones for periods varying from 13 days to 10 months. Twenty-two experiments of a similar character are recorded by Mr. Cheyne in this number of the *British Medical Journal*. The disease of the knee-joints produced must have caused, for long periods, excessive pain to the animals.

English. Mr. Watson Cheyne also experimented in a similar manner upon goats. He says, "I have performed three sets of experiments on goats." In Experiment XXIII. the right tibial artery was exposed and tubercle bacilli injected. The animal was somewhat lame for a few days after the operation, and in three weeks the ankle-joint began to swell, and "the animal limped very much, hardly putting the foot to the ground. The goat died fifty-one days after the operation." In Experiment XXIV., after the inoculation "the knee and wrist-joints became swollen. As the goat was weak and ill, and apparently suffering pain, it was killed forty-seven days after the injection." In another experiment, "the wrist-joint began to swell in the course of about three weeks, and this swelling steadily increased for about eight months."—(*British Medical Journal*, April 18, 1891, p. 840.) [The use of anæsthetics in either of these sets of experiments would, of course, save the animals only a mere fraction of their pain.]

Foreign. M. Hénocque (*Rev. de Thér. Méd. Chir.*, March 15, 1891), has recently tried the effect of tuberculin in a monkey which presented no symptom of pulmonary phthisis. "Two days after the first injection the animal, which had exhibited the characteristic reaction, presented dulness and a few râles at the right apex. After the third injection the dulness was more marked on the right side, and began to be preceptible at the left apex. Soon all the symptoms of acute phthisis manifested themselves with intense fever, the animal

dying ten days after the last injection after losing a tenth of its weight during that time. The total amount used was six milligrammes of the diluted fluid. On *post mortem* examination, four tuberculous nodules of the size of a pea were found in the right lung, and caseous pneumonia involving two-thirds of the organ in the left. In both cases the tuberculous lesions were surrounded by a zone of very intense red hepatisation. Pieces of the caseous tissues were injected into two guinea-pigs—in one after mixture with sterilised water, in the other with diluted tuberculin. Both animals showed signs of cutaneous and glandular tuberculosis.”—*Supplement to British Medical Journal*, April 4, 1891, p. 109.

English. A paper was communicated to the Bacteriological Section of the recent International Congress of Hygiene held in London, by A. E. Wright, B.A. Camb., M.D. Dubl. It contains an account of a great number of experiments connected with “Wooldridge’s Method of Producing Immunity against Anthrax by the Injection of Solutions of Tissue Fibrinogen.” We are informed (p. 643) that in the first experiment the “fluid was injected directly into a vein of the right ear of a rabbit, and the other ear was immediately inoculated with virulent anthrax. A control was inoculated at the same time. Both these rabbits died between the thirtieth and fortieth hour after inoculation.” “The inoculated left ear of the rabbit was intensely oedematous.” Another inoculated rabbit died from anthrax or malignant pustule, in 46 hours. Another animal lingered to 120 to 135 hours. After this course of experiment the vivisector says—“I undertook a new series, this time a series of twelve rabbits,” nearly all of which died from anthrax in more or less prolonged suffering. After detailing the results of three series of these experiments, he says: “This is the last series of experiments which I can regard as completed, and therefore the last I can record before sending this communication to press.”—*British Medical Journal*, Sept. 19, 1891.

English. The first experiment of this series consisted in inoculating, on April 19, a cow with a broth culture of the diphtheria bacillus derived from “Cow No. 1” of the previous series. Another cow was inoculated with an “agar

culture" of the same bacillus from the same cow. Each cow was inoculated in the left shoulder. Two days after, cow No. 3 had a "big tumour on the left shoulder, tender and soft to the touch." "On April 27 the tumour of cow No. 3 had much enlarged, and was very painful to the touch. The animal had now conspicuously fallen away in the flanks. "She moaned, fed but little, did not ruminate, and her milk secretion had almost ceased." This animal lingered on in suffering till May 5, when she was "found dead" in the morning. Cow No. 4 had tumours along the spine on both sides, became weak and unable to stand, and died on April 29.

In Experiment II. two other cows were inoculated with an agar culture.

In the third experiment two cows were inoculated in the right shoulder with a Pravaz syringe full of a broth culture of the bacillus from a human source. This was done on June 24. The animals were killed on July 10.

The fourth experiment was on two milch cows. They were inoculated subcutaneously on January 27 with one syringe of a "subculture"—that is, a product of many series of cultures—of the human diphtheria bacillus. After these came other experiment on milch cows, calves, cats and guinea-pigs.—From the *Supplement to the XXth Annual Report of the Local Government Board for 1890-91*, p. 220. By Dr. Klein. N.B.—These experiments are paid for by the nation.

CREATION OF DISEASE

(C.)

BY INOCULATION IN THE EYES.

English. The following experiments were made by Dr. Watson Cheyne:—

“Experiment V., November 7, 1882.—Experiment with pus from the wound of a patient suffering from pyæmia. The pus was thick and foul smelling.

“1.—One minim was injected into the left eye of a rabbit. Panophthalmos” [inflammation of the eye, involving every part of it] “resulted, and the animal was ill for some time. It, however, gradually recovered, and in December was apparently well. It died on January 10, 1883. Lived 64 days.”

“Experiment XIV., November 2, 1882.—The bacilli were rubbed up with boiled distilled water as usual. A little of the pure material was injected into the right eyes of three rabbits. Into the left eyes the following materials were injected:—

“No. 1.—One part of the fluid containing bacilli was mixed with one part of a 1 per 1,000 watery solution of bichloride of mercury. This mixture was allowed to stand for twelve minutes, and then injected into the left eye of No. 1.

“Result in No. 1.—On November 23, 1882, it was found there was a well-developed tubercular iritis [inflammation of the iris—the coloured part of the eye surrounding the pupil] in the right eye, but apparently nothing in the left. On December 10, 1882, the left eye was beginning to show appearances of tubercular iritis; the right eye became converted into a caseous” [cheese-like] “mass. This animal died on January 7, 1883. Lived 66 days.” —“Report to the Association for the Advancement of Medicine by Research,” *Practitioner*, April, 1883.

Foreign. Deutschmann, together with Clifford, made some experiments on the eyes of rabbits for the purpose of producing sympathetic inflammation of the unoperated eye. The eye of the animal was injected with the spores of *aspergillus glaucus* (a fungus), or the optic nerve, after partly dissecting out the eye, was similarly injected. No mention of anæsthetics, but they or curare may have been given to keep the animal quiet during the operation. Some of the animals were left for weeks after the operation. When inflammation had set in, and had reached the eye not operated upon, the rabbit was killed to see the traces of the poison. The results were only partially satisfactory from a scientific point of view.—*Gräfe's Archiv.*, Vol. XXVIII., 1882, pp. 291-300.

Foreign. Dr. R. L. Randolph injected an emulsion of *staphylococcus aureus* into the crystalline lens of one eye of 15 dogs and five rabbits to test whether destruction of the other eye would result. The injected eye generally became useless.—*Arch. f. Augenheilkund*, XXI., p. 159.

English. Dr. E. Klein, F.R.S., in his *Further Report on the Etiology of Diphtheria* (Appendix B) makes the following statements (p. 156):—

“In last year's Report I have shown that with diphtheria membrane, a definite infectious inflammation of the conjunctiva and cornea” (of the eye) “leading to corneal ulcer, can be produced in the cat by rubbing a particle of the diphtheritic membrane over the cornea and conjunctiva, from which the surface epithelium has been previously scraped off. . . . Before the end of the week the cornea shows distinct ulcer. The corneal tissue becomes at the same time loosened and opaque, the conjunctiva much inflamed, œdematous, and at the internal canthus there collects muco-purulent matter.” . . .

“During the year just past” (presumably 1889) “a number of additional experiments on the cat's cornea and conjunctiva have been instituted with cultivations of this diphtheria bacillus. . . . I subjoin a few instances of successful inoculation of cats.”

“1. With this cat's cornea bacillus, carried on in a series of subcultures . . . the scraped cornea of a fresh cat was inoculated.

"2. From a subculture the scraped cornea was inoculated in two cats.

"3. From a culture, the cornea and conjunctiva (previously scraped) of two cats were inoculated. In both these animals the disease set in with great intensity. . . . On the fourteenth day both eyes of this cat were closed, copious muco-purulent matter had collected. . . . This animal was killed on the seventeenth day; the disease still progressing. The ulcer on the cornea reached down to the Descemet membrane.

"4. From an agar subculture, the corneæ of two other cats were inoculated. . . . One of these cats was killed on the fifteenth day. One cornea was opaque, the other showed a deep crater-like ulcer with raised opaque margin; conjunctiva much congested, swollen and coated with purulent matter. The other cat had considerable suppuration from the conjunctiva of both eyes.

"5. From a gelatine subculture, the cornea of a cat was inoculated. On the fourth day there was a distinct ulcer on the cornea, with great congestion of the conjunctiva and muco-purulent discharge. The disease increased steadily until towards the middle of the third week, when there occurred perforation of the cornea, and the formation of staphyloma. The margin of the cornea had now become swollen and opaque, the conjunctiva bulbi, œdematous and deeply congested. The animal was killed about the end of the third week."

After this we hear of four other cats similarly diseased, the last being killed on the seventh day, with a "crater-like ulcer" on its eye.

After these twelve cats follow another series of experiments on cats by inoculating them with diseased matter in the groin. Two were "found dead" at the end of five days, two others after ten days, and the last two after eleven days. The *post mortem* showed "extensive hæmorrhage in the subcutaneous and muscular tissues, with œdema in the groin, abdomen, and thigh; the tissues in many places discoloured, appearing as if split up by clefts into lamellæ, and almost gangrenous. The lungs and spleen were congested, the liver slightly congested, and both kidneys showed enlargement, and a remarkable change, which consisted in almost the entire cortex being grey and fatty degenerated."

Then follow the records of several more cats inoculated in the groin; and we are told that "An interesting result is obtained

when cats are simultaneously inoculated superficially in the cornea, and subcutaneously in the groin." . . . The animals so treated when killed seven days and nineteen days afterwards, exhibited the usual symptoms.—*In the Supplement to the Nineteenth Annual Report of the Local Government Board for 1889-90*, pp. 143—176. [For these and similar experiments Dr. Klein received £670 of public money in the year in question.]

Foreign. Dr. Theodor Leber injected blue mould into the eyes of rabbits, guinea-pigs, and frogs. He inoculated the eyes of rabbits with pure cultures of *aspergillus* and found that it speedily and certainly established violent inflammation and suppuration in the cornea. The inflammation lasted several days.—*Lancet*, June 13, 1891, p. — 1,328.

The *British Medical Journal*, June 6, 1891, contains in pp. 1,222-23 a paper on Leprosy Cultivation, by Mr. A. A. Kanthack and Surgeon-Major A. Barclay, which is instructive as containing the following remarks: "Animal experiments have not given definite results as yet, but it must be remembered that such, in the case of leprosy, are always conducted with great difficulty. Even implantation of tissues into animals has only once been successful in the hands of Melcher and Oltmann, of Königsberg." These experimenters caused dissemination of leprosy by inoculating the eyes of a rabbit with a nodule of leprous tissue.

In the same journal of June 20th, 1891, p. 1,331, the same writers say, "A successful animal experiment would at once decide whether our claims are justified. So far, however, they continue to be in vain, and perhaps also but little result may be expected from them; for leprosy is so exclusively a human disease that one can hardly hope to produce the disease in animals."

CREATION OF DISEASE

(D.)

BY INJECTIONS IN THE EARS.

English. A paper on the Physiology of Gland Nerves, by J. Rose Bradford, D.Sc., M.R.C.S., has a division on "The effects of the destruction of the tympanic plexus in the dog." A muscle known as the digastric was dissected out and turned aside "in the usual manner," and under chloroform and morphia, so as to expose the "tympanic bulla," it was then trephined and the opening enlarged with bone forceps, the interior of the tympanum " [or middle ear] " was next scraped out with a small sharp Volckman's spoon, and then the cavity was scrubbed out with a solution of chloride of zinc [this, as is well known from surgical practice, destroy everything with which it comes in contact, The previous anæsthesia could not have availed to save the animal its prolonged after-sufferings]. The experimenter explains, "By this means the plexus was very effectually destroyed, but it was found that it was exceedingly difficult to manipulate the sharp spoon in such a way as to avoid injuring the membrani tympani. If this membrane were injured it is obvious that the experiment was useless, as the wound would in all probability become septic and so invalidate the result. Hence, although this method was exceedingly successful in a case to be mentioned below, it was abandoned for the above reason, and the following used instead. The bulla was opened in the usual way, and then by means of a capillary pipette three or four drops of *pure* carbolic acid were allowed to run into the tympanic cavity." In some cases the carbolic acid had also destroyed the chorda. On p. 313 we find the following very remarkable statements: "An objection to this fact being due to the excitation of anabolic fibres is that the observed result is due to differences in the anæsthetics. This objection, however, is untenable since in my experiments no

anæsthetic but morphia was used" [Morphia is a stupefiant and not an anæsthetic.] [The pain in this experiment even under anything but the very largest doses of morphia would be terrible]; "no chloroform being found necessary after the operation." "Where the wound was made in removing the ganglion suppurred, the operation was followed by a copious secretion, the saliva constantly dripping from the animal's mouth during the six days following the operation." "There was a continuous and copious secretion of tears. These effects were all observed for as long as seven weeks after the operation, no animal having been kept alive for a longer period than that."—*Journal of Physiology*, Nov., 1888, pp. 287—316.

Foreign. "At the meeting of the Medical Society of Hamburg of June 9, E. Fraenkel demonstrated the cocci of pus procured from inoculation with the cocci of erysipelas. He had already produced a true erysipelas in the ear of a rabbit by inoculation with pure cultivation of the streptococcus, and now he had succeeded with the converse experiment of producing the streptococcus from inoculation with the cocci of erysipelas. Clinical observation confirmed what he had stated. Abscesses containing streptococci were often met with in patients suffering from erysipelas. In a case of secondary facial erysipelas, a point of exit was found in a whitlow under the nail which contained streptococci. In another case a primary erysipelas of the face was followed by a phlegmon of the breast and the mediastinum, as well as by pleurisy. Streptococci were found in all these cases. For the sake of experiment he inoculated pure cultivations of the erysipelas coccus upon the peritoneum of mice, and on the ear of rabbits. In the first case peritonitis was set up, and in the other abscess of the ear. In both cases examination revealed the streptococcus as usually met with in abscesses."—*Medical Press*, August 12, 1891, p. 392.

CREATION OF DISEASE

(E.)

BY INDUCING ABSCESSSES.

English. The first series was conducted by Dr. Watson Cheyne, and is described by him in the *British Medical Journal* of Sept. 27 and Oct. 4, 1882.

Dr. Cheyne writes thus: "In this series (p. 603) I tried whether an injury would give rise to the local development of abscess after injection of micrococci in the veins. Accordingly, a rabbit, having been chloroformed, a fracture of the thigh was produced, and then three cubic centimètres of a cultivation of these micrococci in hydrogen gas was introduced into the jugular vein. The animal was killed after seven days." (P. 645): "February 11, 1882. Incisions were made antiseptically into the lumbar muscles on each side in a large rabbit. A croton-oil tube was introduced on each side; the muscles and skin were stitched over them with catgut . . . the wounds healed . . . On April 6 (fifty-four days later), the tubes were burst by pressure. Swellings formed on each side, and on May 3 the rabbit was killed. On making incisions through the skin and muscles, large abscesses, containing cheesy pus, were found deeply seated."

Stated in ordinary language, the experiment amounted to this:—The loins of the animal were cut open, and glass tubes filled with an irritating liquid were embedded in the wounds: ultimately the tubes were broken, and the liquid escaping diffused itself amongst the surrounding tissues, producing intense irritation and extensive abscesses.

The experiment, in this and other forms, appears to have been tried on a considerable number of rabbits. The condition of one of them is thus described:—

" . . . The skin was involved in the gangrene, and the whole became a putrid mass, full of organisms."—*British Medical Journal*, October 4, 1882.

It is obvious that in these experiments anæsthetics could only have been used for the actual operations. Professor Horsley said, in *Black and White*, November 12, 1892, p. 553, that "muscles are almost insensitive," that the abscesses caused were "cold abscesses—altogether painless," and that "the quotation of this experiment against us is simply an exhibition of the exceptional surgical ignorance of the Anti-vivisectionist agitator." It is not necessary to possess any surgical knowledge whatever to know that croton oil diffused amongst the muscles along with pieces of broken glass must cause pain.

CREATION OF DISEASE.

(F.)

CREATING EPILEPSY BY BLOWS ON THE SKULL.

Foreign. “In the course of some recent experiments on the establishment of artificial epilepsy in guinea-pigs, Dr. C. Westphal has been over the same ground as that explored by M. Brown-Séguard.—He adds some new and interesting facts. Thus, he found that if one or two slight blows on the side of the head are given to a guinea-pig they are sufficient to bring on an epileptiform attack, after which the animal again recovers its liveliness, or it remains heavy for some time and then exhibits a kind of rotatory movement, like those shown by Schiff to occur in rabbits after lesion of the crus cerebri”

Here we are told that after the epileptic zone is established “slight pinching will induce tonic and clonic spasms.” Also “the rapidity with which the zone can be established may be increased by striking the animal’s head on successive days, and the irritability of the zone endures for a period varying from six weeks to six months.”—*Lancet*, No. 2,528, p. 195. (Quoted in Appendix to Report of Royal Commission, pp. 377-8.)

CREATION OF DISEASE.

(G.)

INJECTING FOREIGN MATTER INTO THE BLOOD.

Foreign. Dr. Ivo Novi has tested by experiments on dogs the effects of cooking-salt on the living brain. These studies were carried out in the laboratory of Professor Peter Albertoni in Bologna, and necessitated "a long series of experiments," the first of which was made in November, 1887, on a large old dog, into whose carotid artery a 10 per cent. solution of common salt was injected on two occasions at 16 minutes' interval. The animal was afterwards killed. Other dogs had the carotid artery dissected out, and a cannula inserted into the peripheral end. In one case salt solution and drinking water were both tried. After the drinking water injections the dog recovered. When solution of salt was injected prolonged convulsions set in immediately, accompanied by general tetanus, which also attacked the breathing muscles. When the injection was very strong consciousness was lost, and reflex movement from the cornea failed when the eyelids were opened widely with the fingers. After about two minutes the dog was killed by letting air into the jugular vein. A tabulated list of 13 dogs is given:—"The dog, No. 12, had served for an experiment on the ear about eight hours previously. A very extensive cut through the skin and through the subcutaneous tissue had exposed the *Proc. mastoideus* of the temporal bone and had divided the muscles. Tracheotomy had also been performed on the animal, and extirpation of three rings of cartilage with introduction of cannulæ into both ends. The wound had not been sewn up, but the animal had not lost a drop of blood, and it was well when it left the vivisection table. When, however, it was brought for my experiment it had fever."—*Pflüger's Archives*, Vol. 48 (1891), p. 320, etc.

Foreign. Dr. Pollitzer, New York, published a paper "On the Action of Peptones," &c., in which he says, "The injection was promptly followed by marked signs of distress." "Immediately following the injection there occurs a stage of excitement, with more or less marked manifestations of pain and distress, due no doubt to strong intestinal peristaltic action. . . . This stage lasts from one to two minutes, and is followed by the narcosis." "Four of the injections, with inconstant results, were made into the veins of the same dog, at intervals of time which allowed for the healing of the last wounds."—*Journal of Physiology*, Vol. VII., p. 233.

Foreign. Professor Imanuel Munk injected soap into certain internal veins of dogs. They died in less than an hour. The operation consisted in opening the abdomen to insert a cannula into the splenic vein or into the mesenteric vein, through which he injected the solution of soap. Mention is made of morphia, ether and chloroform in the case of dogs, but fasting rabbits are expressly said to have been rendered motionless by *curare*. One case is mentioned as noticeable. A dog had inadvertently been given an overdose of morphia. He fell into a state of somnolence, and the pulsation of the heart became so weak and irregular that the use of any further anæsthetic appeared dangerous. During the preparatory operation (the laying bare of the vein for injection, in some cases the crural vein) the dog "reacted vigorously, partly by struggling and partly by barking." . . . When the last dose of soap had been injected the dog gave a piercing howl and then was still. "Effects of Soap in the Animal Body."—*Du Bois Reymond's Archives Supplement*, 1890, p. 116.

Rabbits and dogs were used, some of the rabbits dying in convulsions.

English. Dr. Angel Money communicated to the Medico-Chirurgical Society, on May 26, 1885, an account of experiments in which he had injected into the blood-vessels of "rabbits, guinea-pigs, cats, and dogs," such "suitable" substances as "arrowroot particles, granules of potato starch and

carmine," with the result of producing "uncontrollable movements," and in others a condition which the experimenter supposed was the same thing as St. Vitus' Dance in human beings. The experimenter himself thought, however, that the experiments could not upset current theories about St. Vitus' Dance, because the animals used by him are "so far removed from man."—*See Lancet*, May 30, 1885.

English. Drs. Roy and Sherrington bled a curarised and anæsthetised dog to death while its head was kept in an incubator at a temperature of 37° C. A portion of the dead dog's brain was rubbed up in a mortar, with warm solution of salt, and then injected into another dog by means of a cannula tied into the submaxillary artery, and this into the common carotid. On page 92, the experimenters say, "Direct stimulation by the induced current of the medulla oblongata, in curarised animals, causes congestion of the brain." On page 93 they say, "If the animal struggle while under the influence of a weak dose of curare, or when it is under ether, chloroform or morphia alone, the muscular movements are accompanied by cerebral congestion which may be very considerable in extent." On page 94, "The above described results, which were to us at first sight very confusing, cannot all of them be produced at will in the case of any given animal."—Abridged from *Journal of Physiology*, Vol. XI., p. 105.

Foreign. A number of experiments upon rabbits were recently made at Berne by Marie Wassilieff-Kleimann, by injecting a mercurial preparation known as cinnabar in large quantities into their veins. Carmine and indian-ink were mixed with their food. The report informs us that in some animals the experiments, by feeding them on coloured matter, did not succeed, as the animals died of enteritis (inflammation of the intestines, one of the most painful of diseases).—*Arch. Exp. Path.*, XXVI., 3, p. 191.

Foreign. Dr. U. Mosso produced fever in dogs by injecting liquid gelatine containing *staphylococcus aureus* (an agent causing putrefaction) into their veins. The dogs all died,

sonic at the end of twenty-four hours, some after five or six days. In one case the lungs had a large abscess. Mosso observed "that all the animals uttered cries during the last hours of their life as if they were suffering intense agony."—*Archives Italiennes de Biologie*, Vol. XIII., 1890, p. 478.

English. Dr. A. E. Wright, of Trinity College, Cambridge, and University of Dublin, made the following experiments in the Physiological Laboratory of Sydney University :—

"Sept. 22, 1890.—Fox-terrier. Cannula inserted into the jugular vein, trachea compressed with a ligature; as soon as dyspnoea has become marked, 25 cubic centimetres of a solution of tissue fibrinogen were allowed to run into the jugular vein. Respiration came to an immediate standstill. Ligature on the trachea was relaxed, and the *post mortem* was begun immediately. After the *post mortem* had commenced, the animal gave two or three of the deep *ante mortem* gasps constantly seen in asphyxia, through acute deprivation of oxygen"—*Journal of Physiology*, Vol. XII., p. 185, May, 1891.

"I.—The sciatic nerve was exposed as high as possible in the back of the right thigh. It was divided, and the peripheral end was stimulated by a strong interrupted current. After the stimulation had been continued for a couple of minutes, the usual quantity of Wooldridge's coagulating fluid was allowed to flow into the jugular vein, the stimulation being continued while the injection was proceeding. The animal succumbed some few seconds after the injection was completed."—*Ibid*, p. 186.

"III.—The chorda tympani was exposed on one side, and the sympathetic was separated from the vagus at the root at the neck on the other side. Both nerves were then cut across, and their peripheral ends were stimulated. The coagulating fluid was injected into the femoral vein."—*Ibid*, p. 187.

CREATION OF DISEASE

(H.)

*BY ARTIFICIAL INFLAMMATION CAUSING
DEATH FROM PAIN.*

Foreign. “I have on two occasions seen little birds die of pain. In these birds I had passed a rough, coarse, silken thread through the pectoral muscle for the purpose of inducing artificial inflammation. Death was instantaneous, and was caused by sudden failure of the heart's action.”—Mantegazza, *Fisiologia del Dolore*, Florence, 1880, p. 49.

THIRD CIRCLE.

POISONING.

POISONING

(A.)

WITH DRUGS.

English. In describing experiments on living animals with borneol (a form of Borneo camphor), Dr. Stockman stated:—"Observations were made on rabbits, guinea-pigs, cats, and dogs. It is on cats that the symptoms produced by borneol may be observed in their most typical and aggravated form.

* * * * *

"Thus, after administration of 2-3 grms. by the stomach in emulsion a cat shows in about a quarter of an hour symptoms closely resembling those of alcoholic intoxication. It wanders restlessly to and fro, its gait becomes unsteady, and in walking it seeks to support itself by leaning against the wall. Its power of co-ordination becomes much impaired, especially in the hind legs, and even when sitting still it sways gently from side to side. This condition rapidly becomes worse, until progression is simply a series of stumbles, the animal finally lying down on its side unable to rise. . . . The animal, though stupid and intoxicated, retains consciousness. . . . There then begins slight trembling, most marked in the head and neck muscles, which soon develops into violent clonic convulsions involving all the muscles in the body. . . . After it has once begun the trembling is continuous, while sometimes in addition the animal moves its legs backwards and forwards in a rhythmical manner. During this stage the pupils are always widely dilated, and remain so till death. Chloroform completely stops the convulsions. Consciousness gradually becomes abolished and the animal lies on its left side trembling continuously and having at intervals true epileptic convulsions. Sensation also becomes impaired, until even stimulation of the exposed sciatic nerve causes no reflex movement. The animal may remain in this condition for about 48 hours."—*Journ. of Physiol.*, Vol. IX., pp. 70-71 (1888).

Foreign. Dr. W. B. Platt, of Baltimore, M.D. (Harvard),
M.R.C.S. (Eng.), made experiments on the action

of Resorcin on dogs, rabbits, and frogs:—

Series D. “A small, white, female, poodle-dog . . . injected . . . in five places. . . . Dog, until now, quiet, begins to tremble, pants, stands uneasily . . . leans against side of glass cage, growls, whines, and howls . . . falls to floor, tries to rise, cannot walk, arches back, head thrown back, incessant motion of legs . . . biting motion. Struggles increase . . . yelps a few times, attempts to roll over . . . Death after one hour and forty-nine minutes.”

“Experiment 3. A black-and-tan male dog, injected at 5 p.m. April 10, 1882, with 1·5 grammes dissolved in distilled water. . . . This is injected in 5 places beneath skin of abdomen. . . . Up to 5.24 very restless. . . . 5.29, same, seems very unhappy, tremor of hind legs. 5.30, back arched as he moves about; holds up left fore-paw high in the air, quivering. . . . 5.44, staggers, tumbles, steps about constantly. . . . 11th, dog of yesterday seen at 3.20 p.m. . . . Drags hind legs after him as if paralytic, with much difficulty manages to stand. A viscid saliva drops from mouth. . . . 3.40, froths copiously at mouth; lies down as if to sleep. . . . 6.14, gasps, barks, foams at mouth, eyes glare, jaws snap. . . . 6.36, struggles further, a violent spasm, head drawn back at right angles to body, intermittent jerking of limbs. . . . 7.22, dog appears almost normal, with slightly rapid respiration. Still does notice noises or objects; greatly exhausted; animal *now left*. 12th, at 6 a.m., animal found dead after at least 26 hours.”—*American Journal of Medical Science*, January, 1883, p. 100.

English. Mr. G. F. Dowdeswell, B.A., Cantab., F.C.S., &c., made experiments upon cats, dogs, guinea-pigs, and rabbits with the salts of vanadium.

“Experiments upon Cats.” . . . “In Experiment No. 3, for 46 days a dose was administered in food, which produced excessive constitutional disturbance, vomiting, purging, and emaciation; at the end of that period the animal was killed, and fatty degeneration of the organ [the liver] was found distinctively pronounced.”—*Journal of Physiology*, Vol. I., p. 260.

English. Experiments on the physiological action of vanadium were carried out by Mr. John Priestley, at Owens College, Manchester, during 1874 and 1875.

The vanadate of sodium was introduced into the bodies of frogs, guinea-pigs, rabbits, cats, dogs, and one pigeon, 74 in all, by (1) injections under the skin, (2) injections into blood-vessels, and (3) by introducing it by means of a tube into the stomach.

Exp. XV. A guinea-pig had 25 milligrammes of $V_2 O_5$ injected under skin of right shoulder. The report states: In nineteen minutes, "Very uneasy; runs round box uttering slight cries. Twitches of head." Diarrhœa and swelling of abdomen are present. One hour afterwards it "contrives to get into a corner and moans, twitching its head convulsively." In twenty minutes more, we find its "respirations 132 per minute." In fifteen more, it "cries when the abdomen is touched." A little further on it is "evidently very uneasy; cries continually. Respirations 140 per minute." "Gurgling noise in throat; struggles as if in great pain; drops of serous fluid exude from nose; asphyxia; eyes prominent; gasps at intervals of 5 to 6 seconds; heart has ceased to beat; serous exudation from nose and mouth," and death $8\frac{1}{2}$ hours after injection.

In Exp. XXVI., upon a "small, rough, young terrier," during a period of 11 hours and 5 minutes from an injection under the skin, the record gives: "Much terrified; slight diarrhœa; vomits a stringy mucus; walks quite well." "Attempts to vomit ineffectually." "Appears unable longer to support itself, and has fallen over on to its side; breathing short and irregular; quite conscious." Bloody diarrhœa now comes on with heavy breathing, but "quite conscious," according to the report, for three hours longer.

In Exp. XXVIII. upon a small adult cat, during two hours, we get vomiting, "great contractions of abdominal muscles, and diarrhœa. Again sick." "Respirations 16 in 10 seconds." [Eight to ten times more rapid than the normal.] Within one hour from the injection it "rolls over two or three times as if in pain; breathing very rapid and shallow. Rises, but cannot stand; lies on its side, stretches out its fore-paws and seizes with them the bars of its cage. Slight opisthotonos." [Convulsions in which the contractions of the powerful muscles of the back curve the body in such a way that the head and the heels have a tendency to meet.]

In Exp. XLV. we have a kymographic cannula inserted into the left carotid artery of a male rabbit; in XLVI. the same instrument is inserted into the left femoral artery; in XLVII. the kymographic cannula is placed in the left carotid artery, a cannula in the vein for injection, and into the windpipe for respiration tracing; in XLVIII. and XLIX., in addition, the vagus nerves are exposed also in rabbits, after which we have the injections made, and the struggles and other symptoms, which lasted from 12 to 41 minutes, chronicled without any anæsthetics having been administered.—*Paper read before the Royal Society, 18th November, 1875.*

English. Dr. John G. McKendrick, Professor of Medicine at Glasgow University, and Mr. William Snodgrass, of the Physiological Laboratory at the same place, report some experiments on the Physiological Action of Carbon Monoxide of Nickel. The chemical was first tried upon frogs; it was injected under the skin of the back; we are informed that "the substance evidently acted as an irritant, as the animal contorted its body and rubbed the skin over the seat of the injection with its hind limbs;" paralysis, difficult breathing, and death supervened. The second frog croaked repeatedly; its "eyes were remarkably prominent;" it died with the same symptoms as the other frog. From frogs they proceeded to a white mouse; paralysis, gasping, and death resulted from the injection. Next a rabbit was taken, and similar phenomena were recorded. In the case of the second rabbit, we note that amongst other results of the poisoning there were twitchings of the legs, the blood-vessels of its ears were full of bright red blood, a severe convulsive seizure with gasping took place, and the animal died, after a period of four hours eighteen minutes, in "a severe convulsive spasm." Several other rabbits were poisoned by carbon monoxide of nickel with more or less similar symptoms.—*British Medical Journal, June 6th, 1891.*

English. Drs. Ringer and Munrell experimented with "the powerful and interesting drug *Pituré*." They say, "We began our investigations on August 16, by injecting under the skin of a small cat one minim of the 1 in 20 solution. In three minutes the cat staggered while walking. In seven minutes the

animal could walk, though barely; it lay down on the table. In eight minutes it was still weaker, so that when lying down it let its head rest on the table. The breathing was 32 per minute, and laboured, but the mucous membrane of the mouth was not at all livid. . . . we observed muscular cutaneous twitching. In thirteen minutes it seemed sleepy, but could see, hear, and feel distinctly. In fifty minutes it could still walk, but rolled a good deal, and the muscular weakness was shown by the ease with which we could open its mouth. The mouth, which at first became a little moister, was now decidedly dry. Respirations 20, rather deep. In 25 minutes the cat began to improve, though the mouth remained a little dry; and in 30 minutes, with the exception of a little dulness, it had recovered. . . . In 34 minutes we again injected two minims of the solution. In one minute the breathing rose from 28 to 36 per minute, and became laboured. In four minutes the cat vomited violently," and so on. "We then applied a small quantity of the alkaloid solution to the right eye of a cat." . . . "We next injected six minims of the 1 in 20 solution under the skin of a moderate-sized cat. In one minute it staggered much in walking, and the breathing became panting. In eight minutes the movements were quite stiff, the legs seemed without joints, and the cat seemed walking with sticks not legs. The limbs were evidently rigid from strong muscular contraction. The respirations were 130 in the minute, and the mouth was covered with foam, a few drops of saliva dropping on to the table. The mouth was very moist . . . in nine and again in ten minutes, the cat vomited. . . . The ears twitched a good deal, and the third eyelid was partially closed. In this state the animal continued till 13 minutes after the injection, when all the parts of the body twitched violently, the twitchings being brought on by tapping the animal or gently pinching the skin, or even tapping the table or blowing on the animal. . . . In 15 minutes the animal lay on its side panting, the breathing being very superficial; it looked as if it were dying."—*Journal of Physiology*, Vol. I., p. 377.

POISONING

(B.)

BY CURARE.

Foreign. Claude Bernard (the greatest authority upon, as he is the greatest discoverer of, the effects of Curare) says in the *Revue Scientifique*, for 1871-2, p. 892: "Curare acting on the nervous system only suppresses the action of the motor nerves, leaving sensation intact. Curare is not an anæsthetic." Vol. VI., p. 591: He says that Curare renders all movement impossible, but it does not hinder the animal from suffering, and from being conscious of pain. These opinions of his are to be found repeated many times in the same work, in which he also mentions that they were proved on a human patient inoculated with Curare who was quite sensible throughout, and suffered frightful pain. Even in his latest remarks on the same subject (Vol. 1874-75, p. 1,117) he refers to experiments where the patients on their recovery had been able to relate "that during paralysis they had been fully aware of their existence, and of all that happened around them." Vulpian also, the next best authority, says in the latest work, *Leçons sur l'Appareil Vaso-moteur*, Paris, 1875, p. 660: "Curare does not act on the sensory nerves, or, at least, does not abolish their function."

Again, Claude Bernard, in his classic paper on "Curare," in the *Revue des Deux Mondes*, for September, 1864, after quoting the opinion of travellers, and more especially of Waterton, says (p. 173):—

"Thus all their descriptions offer us a pleasant and tranquil picture of death by Curare. A gentle sleep seems to occupy the transition from life to death. But it is nothing of the sort; the external appearances are deceitful. In this paper it will be our duty to point out how much we may be in error relative to the

interpretation of natural phenomena where science has not taught us the cause and unveiled the mechanism. If, in fact, we pursue the essential part of our subject by means of experiments and enter into the organic analysis of vital extinction, we discover that this death, which appears to steal on in so gentle a manner and so exempt from pain is, on the contrary, accompanied by the most atrocious sufferings that the imagination of man can conceive (p. 182). In this motionless body, behind that glazing eye, and with all the appearance of death, sensitiveness and intelligence persist in their entirety. The corpse before us hears and distinguishes all that is done around it. It suffers when pinched or irritated; in a word, it has still consciousness and volition, but it has lost the instruments which serve to manifest them.”—*Revue des Deux Mondes*, September, 1864.

This is the substance of which the same Claude Bernard in his last work says :—

Curare is now employed in a vast number of experiments as a means of restraining the animals. There are but few observations of which the narrative does not commence by notifying that they were made on a curarised dog.—*Leçons de Physiologie Opératoire*, Paris, 1879, p. 168.

In his lectures on asphyxia, Bernard took a dog which was laid out motionless in the vivisection trough. He injected curare strong enough to render it motionless; he pointed out to his hearers that it would have been suffocated, but that the apparatus for artificial respiration was used. “Except that the animal is deprived of the faculty of motion, it possesses all the attributes of life and health, all its organs exercising their normal functions.” When the machine stopped the dog ceased to breathe, when the machine was made to work again breath returned to the dog. In some cases he plugged the dog's nostrils.—Claude Bernard, *Leçons sur les Anæsthetics*, p. 469.

POISONING

(C.)

BY VENOM OF SNAKES.

English. Examples of Sir Joseph Fayrer's experiments with snake poisons:— "1.30.—Three drops (of venom) diluted with water injected into the flank of a dog. Immediately after the injection the corresponding leg was drawn up partially paralysed.

"1.32.—He walks less steadily. Tail rigidly held out.

"1.35.—Restless and whining. Walks about and then sits down again. Walks unsteadily.

"1.45.—Distinct muscular twitches in the shoullder. General tremor.

"1.47.—Twitching of the back.

"2.8.—Is pawing and licking his lips. Vomits.

"2.22.—Has been continually vomiting. The rejection consisted at first of food, afterwards of tenacious mucus. He now lies down, apparently exhausted. He is still trying to vomit, but can bring nothing up. He tries to rise, but cannot. Convulsive strnggles occur.

"2.25.—Breathing ceasing, cornea still sensitive. Convulsive attempts to vomit.

"2.27.—Heart still beating strongly. Death soon followed.

"Experiment 3. Dissolved five milligrammes of dried cobra poison in one and a-half cubic centimetres of water, and injected it under the skin of the left hip of a guinea-pig. In three-quarters of a minute after the injection the animal became restless and uneasy, and began to cry and to give little starts. Three minutes later the starting motions became stronger, the hind quarters of the animal being jerked upwards, and the chin drawn in towards the body; continues to cry. Fifteen minutes after, as the guinea-pig seemed less restless, a second injection of poison was made. Immediately the restlessness increased. Shortly afterwards the animal seemed

to be trying to vomit. Twenty-seven minutes after it could not walk rightly; the hind legs were paralysed and spread out laterally from beneath it. Twenty-nine minutes after, its respiration became very slow and feeble; the animal lay quiet, but convulsive twitches of the limbs followed almost every respiration. Dies." Seven similar experiments are recorded.—*Proceedings of the Royal Society*, Vol. XXI., No. 145, pp. 365-70.

A full-grown dog poisoned in the thigh. The dog limped on the bitten leg and seemed restless and uneasy, retching, very restless, breathing hurried. Twelve minutes after, it vomited, then staggered, became convulsed; diarrhœa succeeded. It rose, staggered, fell over, and was seized with convulsions. In 18 minutes it was perfectly paralysed, but the heart still beat; there was no respiration. Twenty minutes after the bite it died.—*Edinburgh Medical Journal*, 1870-71, p. 721. There are over 280 of these experiments performed by Sir Joseph Fayrer, on dogs, kids, birds, pigs, cats, horses, and rabbits. In some instances the pain of the victim was prolonged seventy hours.

Foreign. "I have made more than 6,000 experiments; I have had more than 4,000 animals bit; I have employed upwards of 3,000 vipers, and may have been deceived; . . . my conclusions may have been too general, my experiments too few in number."—*Treatise on the Venom of the Viper, &c.*, by F. Fontana, translated by J. Skinner, Vol. II., p. 73, London, 1787. (The preface to the French edition quotes this also.)

English. Dr. George Harley poisoned dogs with snake bites. "The experiments were performed at University College in the presence of my colleagues, Professor Sharpey, Ellis, and Williamson. . . . A large dog was bitten by one of the snakes over the right eye. . . . In three minutes the dog became very restless, and gave a low whine as if in pain. After moving about the room for ten minutes searching for a comfortable place to lie down on, he placed himself in the coolest part of the chamber, and laid his head on the cold stones, as if to relieve headache. He moaned as if in distress . . . As the effects of the poison passed away, the pulse gradually recovered . . . The serpent was once more

allowed to bite him. The same train of symptoms again appeared, but in a more intense degree, and within twenty-five minutes he had become insensible Half-an-hour after being bitten the second time, convulsive twitchings began to appear in the fore limbs and muscles of the neck. In ten minutes more the whole body became convulsed. The limbs were stretched out and the head jerked backwards In two hours and a-quarter the animal appeared to be dead, but on making an incision into the thorax he gave a gasp. After waiting some time without observing any further sign of life, another incision was made, when he again gasped, but only once."—*Trans. Roy. Soc.*, Vol. CLV., p. 700.

Foreign. Experiments with Rattlesnake Venom, by Dr. H. Sewall, Professor of Physiology, in the University of Michigan. "Pigeons are peculiarly sensitive to the influence of rattlesnake poison, and these birds were therefore uniformly used in these experiments. When a fatal dose of poison is given, the paralysis extends from the legs to the wings, the head rests upon the floor, the month is open and the respiration gasping, and after a longer or shorter period of clonic convulsions, the pigeon dies." One pigeon died in two hours thirteen minutes. Another inoculated, Nov. 4, at 3.25 p.m., fell to the floor at 4.50, paralysis beginning in legs, at 5 p.m. convulsions. "Still alive at 5.25, but found dead next morning."—*Journal of Physiology*, Vol. VIII., p. 206.

POISONING

(D.)

WITH ALCOHOL AND ABSINTHE.

Foreign. "If one continues to administer a daily dose of alcohol sufficient to bring on intoxication, one remarks in the dog from about the fifteenth day a nervous excitability of quite peculiar character. The animal is melancholy and uneasy; he listens, the least noise makes him start; when the door is opened, seized with fright he runs and crouches in the darkest corner of the room; he no longer responds when patted; he runs away and tries to bite when one attempts to take hold of him, and utters sharp cries at the mere threat of blows. This irritable and timid condition increases each day, and from the end of the first month, illusions and hallucinations becoming added to it, it is transformed into a veritable delirium. In the middle of the night he utters plaintive moans, or even whilst all is quiet he begins to bark, the cries becoming louder and more frequent as if an enemy were approaching: speaking or calling does not reassure him, one must interfere with a light. At last during the day he growls without cause; then thinking that he is pursued, he cries out, runs scared hither and thither with his head turned back and snapping in the air."—Dr. Magnan, *The Lancet*, Sept. 19, 1874, p. 411, *Appendix to Report of Royal Commission*, p. 369.

"What we see in the dog, in some cases after intravenous, subcutaneous, or stomachal injections of essence of absinthe is as follows:—In the interval between two epileptic attacks, and sometimes before the convulsive symptoms, or even without convulsions, the animal is seized with an attack of delirium. All of a sudden he erects himself on his paws, the hair bristles, the look becomes wild, the eyes injected and brilliant, staring at some particular spot where there is nothing apparent to draw his attention; he

barks furiously, advances and retires as before an enemy, with open mouth, he throws his head suddenly forwards, and immediately shuts his jaws and shakes them from side to side, as if he wished to tear his prey in pieces. This attack of delirium may recur several times; then the effects pass off, and the animal becomes quite calm."—Dr. Magnan, *Lancet*, September 19, 1874, p. 411, quoted from *Appendix to Report of the Royal Commission*, p. 369.

Foreign. "Dr. Gréhant recently made an interesting communication to the Biological Society, on the quantity of alcohol that would be necessary to produce fatal effect. With this view he performed a series of experiments, the results of which were not always identical. By means of an œsophageal tube, Dr. Gréhant injected into the stomach of a dog thirty grammes of alcohol every half-hour until the animal died. At the *post mortem* examination, he found that the blood of the animal contained a proportion of one part of absolute alcohol to 100 parts of blood."—*Lancet*, January 20, 1883, p. 125.

Foreign. Dr. Carpenter mentions some experiments made by Dr. Huss, of Stockholm, upon dogs; when these animals, having been dosed with brandy during several months, were in the advanced stage of the disease (which he was studying for the benefit of Humanity), designated by Dr. Huss *Alcoholismus chronicus*, although scarcely able to stand, they were always aroused from their apathetic condition by the sight of other dogs, endeavouring even in their weakened state to attack and bite them, and this irritability showed itself to the very last.—*Principles of Mental Physiology* (London, 1876, p. 650).

Foreign. M. Haussonville, writing in *Le Combat contre le Vice*, tells us the following fact:—"L'alcool par lui-même est un poison. M. le docteur Dujardin-Beaumetz a établi ce fait d'une façon irréfragable par une série d'expériences bien conduites qui ont abouti à la mort de deux cent cinquante huit chiens."—*Revue de Deux Mondes*, January, 1887, p. 139.

Foreign. R. H. Chittenden, Professor of Physiological Chemistry in Yale University, tested the effects of

alcohol on dogs. For this purpose he confined them in cages. One dog was shut up in a cage for twenty-eight days, and alcohol was administered during ten days of this period. The quantity given was from 290 to 299 cubic centimetres of absolute alcohol. The animals lost a considerable quantity of hair, they became drowsy, with a tendency towards stupor, and they slept throughout the greater portion of the period of their imprisonment. There was a slight weakness of the hind legs, the animals being evidently intoxicated. These researches were made in January, February, and March, 1891.—*Journal of Physiology*, Vol. XII., No. 3, p. 220.

Foreign. Dr. Audigé, of Paris, also tested the effects of alcohol and absinthe on animals. "Alcohols

administered in a slow and continuous manner were found to give rise to various disorders. Vomiting of biliary matter and of glairy mucus, together with more or less severe diarrhoea were observed, difficulty of breathing, muscular tremor, and even paresis of the hinder extremities were also recorded. . . . Absinthe when given to the animals gave rise to great excitement, with muscular contracture and cutaneous hyperæsthesia." "Two pigs at the end of three years succumbed to the injection of different forms of alcohol."—*Lancet*, June 30, 1883.

LOATHSOME FEEDING

(E.)

WITH DISEASED MILK OR FLESH.

English. Drs. Shattock and Ballance, besides transplantation experiments, fed two rats, male and female, with portions of fourteen fresh scirrhus carcinomata (*i.e.*, cancer) of the breast. These feeding experiments extended over a period of seven months.—*British Med. Journal*, March 14, 1891, p. 567.

Foreign. Prof. Klebs, of Halle, fed a calf on $3\frac{1}{2}$ lbs. of tuberculous human lung, and kept it alive 170 days.—*Deutsche Med. Wochenschrift*, 1882, No. 48, p. 652.

Foreign. "In 1868 M. Chauveau rendered heifers tuberculous by making them swallow tuberculous matter. Parrot repeated the same experiment on guinea-pigs and with the same success. The guinea-pigs were made to swallow the sputum of phthisical patients. Viseur, of Arras, has made cats tuberculous by feeding them with the lungs of phthisical cows."—*Archives Générales de Médecine*, Vol. I., 1883, p. 745.

English. "II. Five fowls, *g*, *h*, *i*, *j*, *k*, were fed with human tubercular matter. One entire human lung (full of tubercular matter) was eaten by them. After a fortnight the experiment was repeated with the same quantity, another human lung full of tubercle.

"Of these five animals:—

"*g* died after 49 days. It was much emaciated; the liver was enlarged, contained numerous patches in its substance. Spleen

also enlarged with numerous yellow tubercles. The intestines appeared normal, the lymphatic (mesenteric) glands were not enlarged.

"*h* died after 49 days. Emaciated; no sign of disease in any of the viscera. Liver and spleen small.

"*i* died after 149 days. Spleen and liver small, appeared healthy; several small yellow caseous patches adhering to the mesentery.

"*j* and *k* were killed after 299 days. No disease discernible in their internal organs. . . ."

"III. Tubercular matter taken from a guinea-pig that had died in consequence of infection with human tubercular matter, was used to *inoculate* two fowls, and to *feed* two others. . . ."

"V. With bovine tubercular matter *fed* nine fowls, large quantities $\frac{3}{4}$ -1 lb. per head of tubercular matter (lung far advanced in the process of tuberculosis) being administered."

The above is taken from Dr. Klein and Mr. Lingard's *Report to the Local Government Board* for 1886, p. 415.

FOURTH CIRCLE.

SUFFOCATION.

S U F F O C A T I O N .

(A.)

*EXPERIMENTS IN APNŒA AND DYSPNŒA
IN ILLUSTRATION OF LECTURES.*

[The following Memorandum was issued a few years ago in Girton College :—]

GIRTON COLLEGE, CAMBRIDGE.

MEMORANDUM.

No Vivisection whatever is practised at the College.

English. Some of the students attend lectures given at the University Laboratory, and on reaching the more advanced part of the course see certain demonstrations illustrating the lectures. Some of these are performed by mechanical apparatus, some are preparations seen under a microscope, some are performed on parts of dead animals, and some—a very small proportion—on living animals rendered insensible to pain by anæsthetics. The following list includes all the demonstrations which have been seen hitherto, or are likely to be seen before the determination of the course of study pursued by students of the College who are now preparing for examination in the subject of Physiology in the Natural Sciences Tripos. The references are to Dr. Foster's *Elementary Course of Practical Physiology*.

(After several harmless demonstrations occurs the following):—

LESSON XVIII., p. 127.

The movements of the diaphragm.

Apnœa.

Slight dyspnœa.

The action of the respiratory muscles in dyspnœa.

(NOTE.—The technical terms in the above veil so completely the nature of the experiments, that it has been thought desirable to

obtain a description of the same in common language, for the use of persons not versed in physiology.) The following has been given by a highly experienced physiologist:—

“In this experiment (Lesson XVIII.) a rabbit was first given chloral, which is not an anæsthetic, but a *stupefier*. An incision was made down the middle of the under surface of the rabbit through the skin, which was either cut away or drawn back, so as to show the muscles of the chest and abdomen at work, and the change of action, according to whether the rabbit was allowed to breathe partially (dyspnœa = difficult breathing), or was not allowed to breathe at all (apnœa = privation of breathing), that is to say, was *choked*. At last, to show the action of the diaphragm or movable muscular partition between the chest and abdomen, the abdomen was cut into, and the movements of the diaphragm watched from below on the dying rabbit.”

S U F F O C A T I O N

(B.)

BY SLOW DROWNING.

Foreign. “Legallois suffocated pregnant rabbits by plunging their heads under water. The little ones were taken alive out of their dead mother twelve, fifteen, and twenty minutes after her death. . . . Buffon repeated the experiment of immersing new-born puppies and kittens in tepid water, several successive times on the same animals, taking care to let them breathe a few times between each trial. This faculty of resisting for a relatively long time the privation of respiration was soon lost.”—Béclard’s *Traité élémentaire*, p. 476, 1880.

English. The following are a few particulars taken from a series of 76 experiments on living animals made by a Committee of which Professor Burdon Sanderson was a member, appointed by the Royal Medical and Chirurgical Society to investigate the subject of Suspended Animation:—

“Seventy-six experiments were made on animals, in only a few of which anæsthesia was present; and after the terrible sufferings caused by plugging their windpipes to suffocate them, holding them under water, and in some cases restoring them to life for further experimentation, burying their heads in liquid plaster-of-Paris or mercury, cauterising their bodies with an iron heated to a white heat, &c., &c., the Committee, it will be seen, report that they were unable to recommend any material improvement in the plan adopted by the Society.—*Appendix to Report of Royal Commission*, p. 365.

English. “A full-grown, healthy dog was suddenly deprived of air by plugging a tube placed in the trachea. Its first struggle occurred in twenty-five seconds; its first respiratory effort was not recorded; its last took

place at four minutes forty seconds, and its last heart's beat at six minutes forty seconds.' (Then follows a series of experiments in which the plug was withdrawn at different intervals, the dogs temporarily delivered from their agonies and subsequently operated on again.) 'Experiment 15.—A medium-sized dog was treated in the above way. The respiratory efforts commenced at two minutes five seconds. As apnœa advanced they became more powerful, and from three minutes twenty seconds and onwards they were very violent till four minutes forty-five seconds, when they ceased. This dog drew the mercury up the tube, by its violent efforts to breathe, a height of four inches, and that height was attained in almost the last attempts at respiration, four minutes forty-five seconds after the establishment of the suffocation. The needle in the heart showed it to be moving up to eight minutes. Experiment 18.—A guinea-pig was held so that its nose was immersed in mercury, the animal being upside down, and the nose inserted sufficiently deep in the mercury to prevent the possibility of getting any air. The respiratory efforts commenced at thirty-five seconds, and ceased at one minute thirty-seven seconds. On examining the lungs, they were found full of globules of mercury, which had thus been drawn up by this weak animal a distance of an inch or two, and that in spite of gravitation.'"—*Report of the Royal Humane Society, 1865, pp. 31-66.*

English. The following is from the Report of the Subcommittee appointed to investigate the subject of suspended animation by means of experiments on living animals:—

Experiment 20. A medium-sized dog was fastened to a board and submerged in a large bath. It was removed in four minutes, but although the heart went on acting for four and a-half minutes longer, it neither gasped nor moved. . . .

Experiment 23. A dog was bound as before to the board and immersed for three minutes fifteen seconds. On being taken out of the water, no respiratory efforts were made; the dog was dead. Bloody froth escaped from its mouth, and its lungs were full of the same material.

Experiment 24. The same as above, but the dog's head was kept under water two minutes only. The dog gasped once or twice, and then died. Lungs full of blood and watery froth.

Five other dogs were then submerged, and removed at graduated intervals of time. . . .

English. Experiment 31. A cat was placed in a cage, and the cage plunged under water. . . . After two minutes the cage with the cat in it was taken out, and the cat was dead.

Experiment 32. A dog was treated in the same way, but the cage was kept submerged in the water only one and a-half minutes. The dog died. . . .

Experiment 38. Two dogs of the same size were fastened to the same plank and submerged at the same moment, but one of them had previously had its windpipe plugged in the usual way and the other had not. At two minutes they were taken out together; the one that had been plugged at once recovered, the other died.—*Appendix to Report of Royal Commission*, p. 366.

The operation for plugging was as follows:—

“The animal was secured on its back, and the trachea was exposed by a single excision in the mesial line of the neck. A ligature having been passed round it, it was opened by a vertical cut, and a glass tube, as large as could be conveniently inserted, was passed into it for a short distance downwards, and firmly secured by the ligature. Through this tube, while patent, the animal breathed freely, but the supply of air could be at once completely cut off by inserting a tightly-fitting cork into the upper end of the tube. It was ascertained by separate experiments that the tube thus plugged with the cork was perfectly air-tight.”

“The duration of the heart’s action was conveniently ascertained by means of a long pin inserted through the thoracic walls into some part of the ventricles. So long as the heart continued to beat, the pin moved, and its motions were thus recorded for some time after the cardiac sounds had ceased to be audible.”—*Report of the Royal Commission*, p. 365.

SUFFOCATION

(C.)

BY PLASTERING MOUTHS OF DOGS WITH
GYPSUM.

English. “Experiment 19. A terrier was deprived of air by plunging its head into liquid plaster-of-Paris; respiratory efforts commenced at one minute thirty-five seconds, and ceased at four minutes, the heart beating till five minutes. On examining the lungs the white plaster was found throughout the bronchial tubes.”—Seventy-six of these experiments were made.—*Report of the Royal Humane Society*, 1865, pp. 31-66.

FIFTH CIRCLE.

BURNING AND FREEZING.

(A.)

BAKING.

Foreign. *Experiments by Dr. Luchsinger, of Zurich, respecting the functions of the Spinal Cord* (p. 524). "In most cases I made the experiments several days after the operation. I put the cats into a hatching-oven, and left them there in a temperature of from 60-70° C. until extreme shortness of breath showed a great degree of heat. I further suffocated the animals till violent cramps attacked the hind parts. In order to perform the operation more leisurely of opening the spinal canal and cutting the spinal cord, I first administered *curare* to the animal. That I might carry the suffocation as far as possible without sacrificing the animal in a single experiment, I connected the manometer of a kymograph with the carotid artery, and thus I had before my eyes a warning signal of the strength and frequency of the beats of the pulse."—*Pflüger's Archives*, Vol. XVI. (1878).

English. Dr. Lauder Brunton, in an article "On the Alterations in the Action of Digitalis produced by Febrile Temperature," in the preparation of which he was assisted by Dr. Theodore Cash, relates how in a series of experiments which he made upon the rabbit, he subjected the animals to a temperature raising the body heat to 113·8° F. In a rabbit with the vagi nerves uncut, the temperature was raised from 100° F. to 111·58° F. In a rabbit with both vagi cut the temperature was raised from 102·4° F. to 113·8° F.

The writers say they made experiments of the same kind upon cats. "In both animals stimulation of the vagus trunk is followed by a slowing and stoppage of the pulse, at least, at ordinary temperatures." "On dividing one vagus in a cat and stimulating the central end, the vagus centre responded to the stimulus, and we obtained, through it, and through the other vagus trunk which remained intact, a reflex action upon the heart, the pulse becoming distinctly slower, although the temperature of the animal had risen to 46·6° [C.] in the rectum, and 45° [C.] [= 113° F.]

in the axilla, and death occurred from heat (hyperpyrexia) almost immediately afterwards."

In Fig. 3, p. 278, is shown "the effect of rise of temperature after the administration of digitalis. At the thirtieth minute tincture of digitalis was injected, and warming was begun. At the ninetieth minute natural respiration ceased, and it had to be continued artificially."—*Practitioner*, Vol. XXXIII., pp. 272-281.

Foreign. Experiments in electrical tetanus by M. Richet:—

"In the dogs the electricity employed was not sufficiently powerful to arrest respiration, and death was due to the elevation of temperature. The ascent of the thermometer was extremely rapid, so that after the tetanus had lasted for half-an-hour the lethal temperature of 111° or 112° F. was reached. . . . The proof that the increased body-heat is the cause of death was furnished by the fact that if the animal is kept cool by artificial means, it may bear for more than two hours extremely strong currents, which cause severe tetanus, without dying for some days. . . . Usually death occurs when a temperature of 112° is attained, but in some cases it reached 112·5 and even 113·3. . . . At 111 the breathing is so frequent that it is hardly possible to count it, and so feeble that scarcely any air enters the thorax."—*Lancet*, September 17, 1881, p. 515.

These animals were subjected for two hours at a time to currents of electricity, causing such intense agony of cramp and heat together that they either expired, with their blood 14 degrees above the normal temperature, or lingered for a day or two, having been "kept cool by artificial means" during the experiment.

Foreign. Bernard, in his *Leçons sur la Chaleur Animale*, gives (p. 347) a picture of a stove with a fire under

it, and a rabbit in the position which would be occupied in an ordinary stove by a cake or pie intended to be baked. He calls it his "First Apparatus for the Study of the Mechanism of Death by Heat." Of the results of experiments with it he prints several tables.

These tables show how dogs, pigeons, and rabbits baked in the stove, expired at the temperatures of 90° or 100° C. (= 194 to 212° F.) in 6 minutes, 10 minutes, 24 minutes, &c.; and again

how, when, the apparatus formed a hot bath (*i.e.*, the animal was boiled instead of baked alive), a different scale of heat and subsequent death was observed. A small dog placed in a temperature of 55° expired after 8 minutes, and so on. Again, another series of results was obtained when the head of the victim was kept outside the stove, while its body was being baked. "The animals" (M. Bernard notes, p. 356) "exhibit a series of symptoms always the same and characteristic. At first the creature is a little agitated. Soon the respiration and circulation are quickened. The animal opens its mouth and breathes hard. Soon it becomes impossible to count its pantings; at last it falls into convulsions, and dies generally suddenly in uttering a cry."

In a subsequent table M. Bernard gives the particulars of the experiments in this apparatus on numerous dogs, rabbits, guinea-pigs, and pigeons; and then proceeds in the next lecture to show his audience the diagram of another and more elaborate stove, in which many other series of animals were sacrificed.

"The machine which served for our first experiments presented an imperfection which rather complicated the phenomena, and might in a certain degree vitiate the appreciation of the action of temperatures on living beings. . . . The machine of which we have more recently availed ourselves has not this inconvenience."

"In the stove we place a sparrow. The temperature is about 65° (Centigrade). At the end of a minute we see the animal open its beak, manifest an anxiety which becomes more and more lively, breathe tumultuously, then fall and die. . . .

"We try the same experiment on a rabbit. The same series of phenomena are exhibited, but more slowly, for it only dies at the end of about twenty minutes."—*Leçons sur la Chaleur Animale*, p. 363, *et seq.*

"Walther found that rabbits and dogs when tied to a board and exposed to a hot sun reached a temperature of 114.8° F. and then died."—*Kirkes' Physiology*, c. X.

Dr. Christian Sibler explains how he baked dogs. He says, "I have repeated all the experiments of Goldstein. Here is one of Goldstein's experiments." "Experiments I., the animal (dog) is placed in a box, and heated, its nose being exposed; the frequency

of the respirations increases as the temperature goes up. The animal is taken out when its temperature has reached 41.2° (C. equal to 106° F.)

Dr. Sibler, concerning Experiments V., which he also repeated, "But I found also that the same increase in the number of respirations took place when the arteries were clamped, so that no blood could pass through them to the medulla. This increase is really, as one cannot fail to observe, brought about by pain; for it must be remembered that water at 54° C. ($= 129.2^{\circ}$ F.), to say nothing of 71° C. ($= 159.8^{\circ}$ F.), is decidedly painful to the hand. That it was pain that called forth these rapid respirations, is shown by the fact, that when I let water of the same temperature (54° C.) run into the wounds made in the highs, the same increase in the respiratory rate occurred."

"As far as the method of observation and the apparatus is concerned, both are very simple. The apparatus consists of a piece of sheet iron, large enough to place the dog-board on it, and of a case or box of wood of corresponding size, open at both ends, with windows and other openings on the side. These, and the ends are closed by cloths, which can be removed or lifted aside when necessary. A thermometer reaching down into the apparatus, through a cork, gives the temperature in the interior. The apparatus was readily heated by one or two gas flames beneath the sheet-iron. . . . In this experiment, the dog was placed in the apparatus in such a way, that its mouth was within, so that it had to breathe a warmed atmosphere. In table I., the experimenter writes at the head, "Male dog—small dose of morphia." In table II., "Bitch—no opiate." When the animal entered the oven, the temperature was 19° C. ($= 66.2^{\circ}$ F.), and its respirations were 22 per minute; in half an hour, the heat of the oven had risen to 51° C. ($= 123.8^{\circ}$ F.), and its respirations were 320 per minute.

"To investigate the influence which the nerves of the skin have in this, the spinal cord was divided at the bottom of the neck, in another dog, and the animal placed in the warm box with its head and neck protruding." In table III., a young dog is stated to have been subjected to a heat of 60° C. $= 140^{\circ}$ F. The spinal cord was cut, and it was placed in apparatus in such a way that the paralysed and anæsthetised parts only were subject to heat directly.—*Journal of Physiology*, Vol. II., pp. 191-201.

(B.)

SCALDING.

Foreign. Lesser (Baron Ladislaus Leo) describes experiments by Sonnenberg, Goltz, Wertheim, and himself. . . . "The researches in burning form a valuable literature. . . . Though death rapidly ensues after burning, there are still many things unexplained. . . . Two dogs had the spinal cord cut through; after several weeks they were scalded. They lived from six to ten days after this, and then died from sepsis with lowering of the temperature of the body. Three other dogs, whose spinal cords were also divided, lived, after being scalded, three days, a week, and three weeks respectively. . . . Numbers of rabbits had their spines cut through; rabbits survived the scalding longest. . . . Five dogs had their spinal cord cut through, and were afterwards burnt. They lived (after a second scalding) six and ten days respectively. A large sheep dog died thirty-six hours after having the hinder part of the body immersed three times in boiling water. The same experiment on a little bitch which had shortly before brought forth. A small lively dog was scalded four times, with pauses of four, twenty-one, and fifteen minutes. It died the following night.—Experiment 47. A young, very lively dog had thirty-one days before had the blood of a scalded dog infused into his body, it was plunged into boiling water of 100° C. (= 212° F.) up to the middle of the body for forty-five seconds. Intense scalding of a dog up to the armpits—death eight hours afterwards. Its skin is said to have been like leather. Several cases of transfusion of blood from a scalded dog."—*Virchow's Archiv.*, Vol. 79, 1880, pp. 248 to 289.

Dr. Von Lesser's researches included the following:—

Foreign. "Experiment 31. A dog was plunged for thirty seconds into boiling water. Next day was very morose and depressed. Died forty-four hours after the scalding."—*Virchow's Archiv.*, Feb. 12, 1880, pp. 248 to 289.

(C.)

POURING MOLTEN LEAD INTO THE
STOMACH.

English. At the burning of Eddystone Lighthouse, A.D. 1755, an old man was injured by the fall of a quantity of molten lead upon him, dying of his injuries in twelve days. He was examined by Dr. Edward Spry, who stated that he found in the stomach a lump of lead three and three-quarter inches long by one and a-half in breadth. As no surgeon would believe this story, Dr. Spry performed a number of experiments on animals by pouring molten lead down their throats, with the result that at the Royal Society, Dr. Huxham, in his letter to Sir William Watson, "testified, to his own belief, in Mr. Spry's veracity." — *Philosophical Transactions*, Vol. XLIX., p. 477, and Dr. Munk's *Roll of the Royal College of Physicians*, Vol. II., p. 282.

(D.)

POURING BOILING WATER IN STOMACH.

Foreign. Dr. Carpenter, in his book on Physiology, mentions a foreign Professor who poured boiling water into the stomach of a dog. "The introduction of a little boiling water threw the animal at once into a kind of adynamic state, which was followed by death in three or four hours; the mucous membrane of the stomach was found red and swollen, whilst an abundant exudation of blackish fluid had taken place into the cavity of the organ."—*See Report of the Royal Commission*, p. 281; also p. 244.

POURING BOILING WATER OVER ANIMALS.

"Dr. Wertheim's experimental studies on burns and scalds made upon the dog." . . . "This pamphlet contains the results obtained by burning and scalding about thirty dogs. Some of these were narcotised by the injection of half-a-drachm of tincture of opium, the others by chloroform inhalations."

Foreign. "Burns were produced by sponging the chests and bellies of the dogs with oil of turpentine five or ten times in quick succession, setting fire to it each time; the scalds by pouring over similar parts eight ounces of boiling water nine times in quick succession. All the dogs died either in a few hours, or at the latest after five days." "For the first few days the wound was covered with sponge, no attention subsequently paid them, and the wounds healed.—*Edinburgh Medical Journal*, 1868-9, p. 1,026.

(E.)

POURING TURPENTINE OVER DOGS AND
SETTING THEM ON FIRE.

Foreign. Dr. Wertheim, of Vienna, experimented on four dogs. After giving the dogs chloroform, or injecting tincture of opium, he poured boiling water over one of them nine times, and he set light to the others three times one after the other after sponging oil of turpentine on the chest and upper part of the belly.

Some dogs were injected with tincture of opium, others chloroformed. It is said at the end that the narcosis was kept up by the injection of tincture of opium into the crural vein as the changes in the organs of the animals were investigated.

The first dog was given opium and set on fire nine times. On the following day the dog was languid and weak. It died 36 hours after the burning. It is said that the changes produced by burning and scalding were studied on the skin of the living dog.—*Wiener Med. Wochenblatt*, 1867.

By these means the chest and belly of the first were scalded, and of the others carbonised.—*Vide The Annual Report of the Royal and Imperial Rudolf Endowment for the Year 1867*, pp. 172-183.

(F.)

FREEZING.

Foreign. “Rosenthal, in 1872, Afanasiew, 1876, Lasser, 1879, as well as Rossbach and Aschenbrandt, 1881, took animals from highly-heated places and put them into icy temperatures. They exposed the mucous membrane of the throats and bronchial tubes of cats, and tried them by alternating hot and cold compresses on their stomachs to disturb the circulation of the blood. These experiments could never be of the slightest use to find out what they wanted.”—Extract from an article on “Loss of Heat,” by A. Kühner, M.D., Frankfort-on-the-Main, in the *Hygieia*, of January, 1892, p. 25.

In February of last year, 1891, M. G. Colin presented to the French Academy of Sciences a report of experiments he made during the severe winter of 1879-80. He hung rabbits in wire cages on to the branches of trees, or exposed them on snowdrifts during the coldest nights. He built huts of enormous blocks of ice, and shut up animals in them, so that the ice should touch their bodies; sometimes he starved the animals for one or two days. Young animals died so rapidly that in the middle of the night or at daybreak the liquids in their bodies were found congealed to solid ice in the digestive organs. Sheep, goats, pigs, and dogs were submitted to the same tests. Dogs shivered and trembled, and one died from the extreme cold.—*Comptes Rendus de l'Académie des Sciences*, Vol. CXII., Paris, 1891, p. 397.

English. A lecture was delivered at the Royal Institution on Friday, May 29, 1885, by Mr. J. J. Coleman, “On the Mechanical Production of Cold.” This gentleman related what he called the “interesting experiments” of Dr. McKendrick in freezing frogs and rabbits to death. Placed in a cold chamber of 100° below zero, in an hour’s time, he says, the animal dies.

“If a rabbit be taken from a surrounding temperature of 35° C. and suddenly cooled, it shivers, and there may be diarrhœa. After two days the temperature rises 1·5° C., and albuminuria occurs. There are microscopic traces of interstitial inflammation in the kidneys, liver, lungs, heart, and nerve sheaths, the dilated arteries of the liver and lung contain thrombi, and in the neighbourhood of the veins are accumulations of leucocytes. In pregnant animals the foetus shows the same conditions.—Landois and Stirling's *Human Physiology*, p. 338.

From experiments by Walther, it appears that
Foreign. rabbits can be cooled down to 48° F. before they die if artificial respiration be kept up.—*Kirkes' Physiology*, c. X.

(G.)

CAUTERISING.

Foreign. Dr. Councilman, of the Biological Laboratory of the Johns Hopkins University, in a paper "On Inflammatory Changes in the Cornea," says: "I have employed various means for exciting inflammation here [in the eyes of frogs]. The passing of a thread through the centre of the cornea and bringing it out through the sclerotic, the application of various caustics, such as croton oil, silver nitrate, caustic potassa, and the hot iron. With few exceptions they produce results relative to the severity of the stimulus used." "Proceeding now to the cat's cornea . . . the animal is first etherised, and the cornea touched with the caustic. . . . The animal is then left in quiet, and the cornea cut out and examined after periods of from 14 to 60 hours."—*Journal of Physiology*, Vol. III., pp. 76-87.

Foreign. Dr. B. F. Lautenbach, of the Physiological Laboratory of Geneva, records experiments "on the Physiological Action of Heat." His researches, if they had any object at all, seem to have been undertaken to prove that some animals rather like to be burned with hot irons than not. He says, "In two cats the hot iron applied to the sciatic nerves failed to produce cries or other reflex movements—applied to the skin, however, these effects were produced. An experiment made on a large brown rat yielded very interesting results. A deep burn made in its ear by means of the hot iron seemed only to tickle the animal. It burned its ear—but it made no efforts to escape. When the iron, which had previously been applied hot, was allowed to cool, and the ear

then scratched with it, the animal made wild movements to escape. Burning its tail with the heated metal caused the animal to lazily turn its head and smell the burned part. Heated water applied to any part of the skin, or underneath the skin, produced the wildest movements to escape."—*Journal of Physiology*, Vol. II., pp. 303—322.

SIXTH CIRCLE.

STARVATION.

STARVATION.

(A.)

KEEPING ANIMALS WITHOUT FOOD.

Foreign. "M. Chossat and M. Strelzoff have made a great number of experiments on pigeons, turtle-doves, hens, guinea-pigs, rabbits and cats, and have arrived at this result—that the animals die when they have lost in weight thirty per cent., that is to say, one-third of the original weight."—Béclard, *Traité élémentaire de la Physiologie*, 1880, Vol. I., p. 754.

"M. Chossat subjected twelve pigeons to complete deprivation of food and drink, and abandoned them thus until they died. He examined them all every twelve hours, at noon and at midnight."—Gavarret, *De la Chaleur produite par les êtres Vivants*, Paris, 1855, p. 394.

M. Chossat describes as follows the symptoms presented by animals deprived of all nourishment. During the first part of the experiment they remain calm, afterwards they become more or less agitated, and this agitation continues as long as their temperature remains high; sometimes, however, it may be perceived at the beginning of the experiment. On the last day of life the excitement ceases, and is replaced by a condition of stupor; the animal, set at liberty, looks about him with surprise, without trying to escape; then he shuts his eyes as if he were sleepy. This state is accompanied by a gradual weakening, constantly increasing; the animal staggers while standing; the head seems giddy; the feet are cold and livid; nor can the animal support himself firmly by means of them. . . . he falls on his side and lies motionless, with no power to rise. At last, growing still weaker, the animal's respiration becomes slower; sensibility diminishes; the pupil is dilated, and life ceases, sometimes tranquilly, sometimes after spasms, slight convulsions, and rigidity of the body.—Gavarret, *De la Chaleur produite par les êtres Vivants*, Paris, 1855. pp. 408-409.

Foreign. Dr. Giovanni Bufalini, Prof. of Siena University, engaged with Prof. Luciani in experiments on inanition by the starvation of dogs.

"A very interesting contribution to the doctrine of inanition. The authors present a graphic table, indicating the quantity of hæmoglobin in the blood, the temperature, &c., according to daily observations on a bitch, subjected for 43 days to an absolute fast with the exception of one ration of water. At the last there were quick oscillations in the temperature, corresponding with the external temperature . . . an interesting fact, which deserves to be confirmed by further experiments which the authors engage to make. A second series of experiments was made on fasting dogs, on which every three days was practised the transfusion of blood." —*Archives Italiennes*, Vol. II., p. 253.

Foreign. Dr. Nasaroff experimented on starving dogs, making them hot and cold by artificial means. When the lowering of the temperature from without was insufficient, he poured a cold mixture through the peritoneum into the opened-up abdomen, in order to chill the animals from within. No anæsthetics are mentioned.—*See Virchow's Archiv.*, Vol. XC., p. 482.

STARVATION.

(B.)

WITHOUT WATER.

Foreign. M. E. Hédon injected paraffin into the pancreatic duct of a dog. The animal was then kept fasting for 12 days; during the latter half of the experiment *no water was given*. The dog died five days after the experiment was ended. A dog without the paraffin injection was kept fasting during the same period.—*Comptes Rendus l'Académie des Sciences*, Vol. CXII., Paris, 1891, p. 752.

STARVATION

(C.)

BY FEEDING WITH UNNATURAL
SUBSTANCES.

Foreign. Dr. C. A. Socin fed dogs on yolk of eggs only. He fed mice on a food prepared from the serum of horses' blood, pigs' fat and starch saturated in hydrochloric acid. The mice lived at the outside 32 days.—*Centralblatt für die Med. Wiss.*, No. 27, July 4, 1891.

Foreign. Schiff introduced sand or small pebbles into the stomachs of dogs through the œsophagus, the pylorus having been first tied, pushing down afterwards a wooden cylinder to act as a piston, and tying the œsophagus to prevent regurgitation. Ether was given at the beginning of the operation.—*Leçons sur la Physiologie de la Digestion*. M. Schiff, Paris, Turin, Berlin, 1867, Vol. II., p. 245.

English. “Dogs were fed exclusively on sugar and distilled water. The emaciation increased the third week. They became feeble. At the same time an ulcer formed on each cornea; this took place in repeated experiments. The animals continued to eat three or four ounces of sugar daily, but became at length so feeble as to be incapable of motion, and died on a day varying from the thirty-first to thirty-fourth. On dissection, their bodies presented all the appearances produced by death from starvation. Indeed, dogs will live almost the same length of time without any food at all. When dogs were fed exclusively on gum, results almost similar ensued. When they were kept on olive oil and water, all the phenomena produced were the same.”—*Kirkes' Physiology*, c. VII., 2.

SEVENTH CIRCLE.

FLAYING ALIVE AND
VARNISHING.

FLAYING.

(A.)

REMOVING SKIN.

Foreign. Professor Paschutin has been studying the respiratory functions of the skin, and has conceived for this purpose the project of tying up dogs for a lengthened period in india-rubber bags. This method has not, however, produced satisfactory results, and to check the action of the skin by other means dogs have been scalded alive. Professor Petermann, a disciple of Paschutin, has carried his experiments further still. He has skinned dogs alive, leaving only those parts covered which were difficult to deal with, namely, the head and the feet. The whole operation is very expeditious, lasting only fifteen minutes. After the operation, the animals (dogs and rabbits) are carefully packed in wadding and rags, but notwithstanding this treatment, they never survive the loss of their natural covering. Several dozens of dogs have had to be skinned alive before this conclusion could be arrived at.—*Nowoje Wremja*, No. 4,584.

Foreign. “Lay bare the two lumbar nerves in the direction of the two posterior members, then place a ligature round the whole trunk of the animal, excepting the two lumbar nerves. The whole of that portion of the animal which is situated below the ligature is now no longer in communication with the circulatory apparatus, and is no longer supplied with blood. Below the ligature there is nerve connection only between the nervous centres and the posterior limbs of the animal. The animal is then curarised, as in the preceding experiment, by making a small incision on the upper part of the back. In a few minutes the whole anterior portion of the animal shows the characteristic signs of poisoning. If the hinder members are stimulated they immediately re-act by contraction.”—J. Béclard, *Traité élémentaire de Physiologie*, Vol. II., 1884, p. 456.

Foreign. *Contributions to the Knowledge of "Innervation of the Blood-Vessels,"* by Dr. K. Grützner and Professor

R. Heidenhain, of the Physiological Institution at Breslau (p. 24). The animal, probably dog, curarised. The left abdominal sympathetic divided; skin removed from both legs. Another dog ditto. One incision at the level of the knee and another at the joint of the foot separated the skin of the lower part of the leg from that of the upper part and that of the foot. The isolated piece of skin then carefully removed (that is to say, that the skin was dissected off from the leg of a live dog, under the influence, not of an anæsthetic, but of *curare*).—*Pflüger's Archives*, Vol. XVI., p. 24.

VARNISHING.

(B.)

COVERING SKIN WITH IMPERVIOUS
SUBSTANCES, SO THAT ANIMAL DIES.

Foreign. Bécclard describes a considerable number of experiments in varnishing animals.

"When animals which have been covered with an impermeable substance are placed in a heated chamber, heated to the degree of their natural temperature, they are not, it is true, prevented from dying, but the moment of death may be retarded, and they may be kept alive a day or even more."—*Traité élémentaire de Physiologie*, 7th Edit., 1880, Vol. I., p. 496.

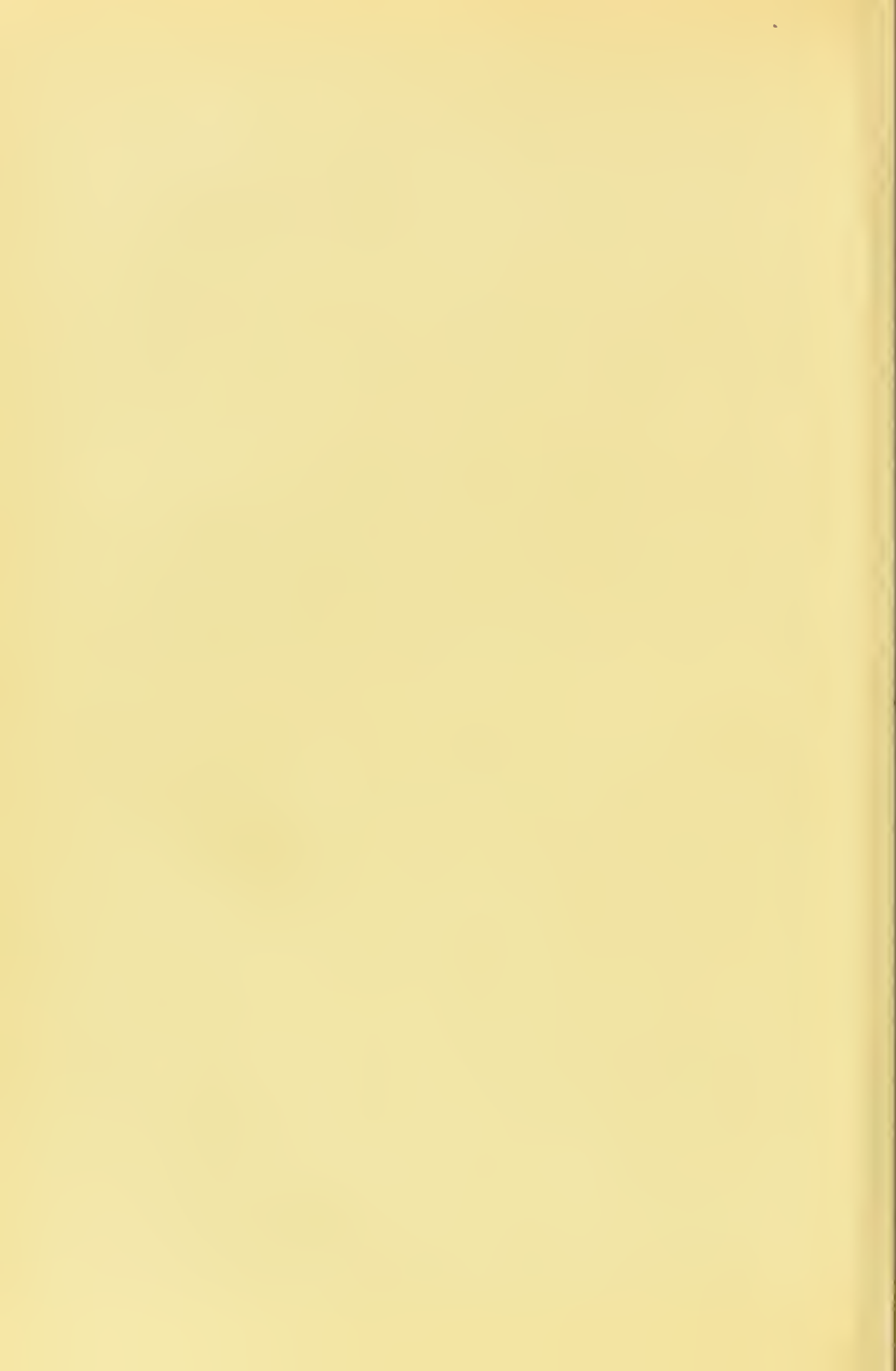
Foreign. Professor Moriggia painted frogs all over with olive oil. If plunged in a bath of olive oil they survived for a few days. When he painted them with a solution of isinglass or with joiner's glue, covering the mouth and nostrils, they died in a few hours. In some cases these "artificial shirts," as the Professor calls them, were cracked by the movements of the animals; this preserved their lives a little longer.—*Archives Italiennes de Biologie*, Vol. XIV., 1890, p. 146.

Foreign. "When, by the aid of appropriate means, we suppress in animals the cutaneous evaporation, and thus absolutely prevent the discharge of water, vapour, and carbonic acid, grave disorders are set up little by little, terminating in death. In order thus to suppress the functions of the skin, it is advisable to lay bare, by means of shaving closely, the whole of the skin of a dog, sheep, rabbit, or horse, and to cover the exposed surface with a thick drying varnish.

Animals thus treated succumb at the expiration of various periods, but they rarely survive twelve hours. After death lesions of the liver, the intestines and the muscles have been found.

"M. Endhuisen has recently confirmed the results which follow the varnishing of animals, and he has succeeded in graduating the duration of the experiment. A rabbit entirely covered with varnish dies in ten hours; but if it be only the twelfth, tenth, or eighth part of the body which is varnished, the animal dies at the end of ninety-six, forty-eight, or twenty-four hours."—J. Béclard, *Traité élémentaire de Physiologie*, Vol. I., 7th Ed., pp. 495-496.

Foreign. R. Winternitz, in Pragne, covered three rabbits thickly with salad oil, rubbing it well into their fur. Two of the animals died; one the following day and the other four days after, both presenting the same symptoms as animals that have been covered with varnish. The third animal was killed after ten days and the *post mortem* showed no abnormal symptoms.—*Archiv. für Exper. Pathologie*, Vol. XXVIII., 1891 p. 412.



EIGHTH CIRCLE.

MISCELLANEOUS
TORMENTS.

MISCELLANEOUS TORMENTS.

(A.)

FASTENING ANIMALS TILL THEY GROW
TOGETHER.

Foreign. "Who would have supposed that a rat's tail after removal of the skin might be kept in a glass tube . . . and yet live on its being placed below the skin of the back of a rat? Through Dr. Bert's kindness I had an opportunity of witnessing the results of two such experiments. In one the revived tail had been frozen; in the other it had been kept in moist air for three days at 121° F.; on the animals being injected, it was found, that there was free vascular communication between the ingrafted tail and the surrounding tissues. He, moreover, finds that the tissues which have been subjected to such modifying influences are liable to fall into certain diseased conditions, the progress of which may be traced by killing the animal at different stages. In the prosecution of this research he is still engaged. He has also succeeded in joining together animals, not only of the same, but of different species, not only rats to rats, but actually a rat to a cat! He effected this by denuding corresponding parts of their sides, and then uniting by means of sutures the skin of the one animal to that of the other, and tying the two animals together, so as to prevent their tearing themselves apart."—Dr. Rutherford, *Journal of Anatomy and Physiology*, 1867, p. 163, quoted in *Appendix to Report of Royal Commission*, p. 368.

"Paul Bert removed the skin from the tip of the tail of a rat, and stitched it into the skin of the back of the animal, where it united with the tissues. After the first union had taken place, the tail was then divided at its base, so that the tail, as it were, grew out of the skin on the back of the animal."—*Landois and Stirling's Physiology*, p. 574, 3rd ed.

English. Dr. Lewis E. Shore, Demonstrator of Physiology at Cambridge, says: "Two animals were taken, two dogs or two rabbits, and the arteries supplying the brain of one animal were gradually ligatured so that its brain was completely prevented from receiving blood from its own heart. The arteries . . . were then connected to the corresponding arteries of the other animal . . . cross circulation was established." [The experiments were carried out under chloroform.]—*British Medical Journal*, November 21, 1891, p. 1,089.

MISCELLANEOUS TORMENTS.

(B.)

TYING LIMBS OVER THE BACK.

Foreign. Two series of experiments were lately performed by American vivisectors, the first by Dr. Phelps, upon dogs, to ascertain the effect upon the joints of putting the limbs into a cramped and unnatural position. In one instance, he took a dog and twisted his leg over his back in what must have been a very painful manner, and then, after fastening it, sealed him up in a plaster-of-Paris bandage, so that he could not possibly move it in the least, and kept him in this way for several weeks. In giving the details of the case, he says himself that in the fifth week the dog began to emaciate, for he could not eat, the pain was so great. We, who know the agony we suffer when we accidentally get a limb into a cramped position, until we can restore it to its proper place, can have some idea what this dog's sufferings must have been.

The other case is that of Dr. B. A. Watson, who has lately written a book describing his experiments upon 141 dogs that he raised to a height of 24 feet and then had them dropped upon bars and ridges of iron to test the effects of the wounds received thereby. In order to increase their injuries, and prevent the resistance that they might naturally make, he had their legs, as he said, "hobbled." Of course their backs were sometimes broken, and sometimes other injuries were the result. The *British Medical Journal*, in speaking of Dr. Watson's book, says: "We trust no one in our profession, or out of it, will be tempted by the fancy that these or such like experiments are scientific or justifiable."—*Inquirer* (U.S.), September 15, 1890.

The experiments to which reference is made are those described by Dr. Phelps in a published paper, entitled "The Question—*Does Prolonged Fixation of Joints Produce Anchylosis?*" In this paper

Dr. Phelps says that it is generally accepted by the medical profession and taught by leading surgeons that ankylosis, or stiffening of a joint, results if the joint is immobilised for any length of time; that motion of a joint is absolutely necessary to prevent this, and that the same rule applies to an inflamed joint.

To determine as far as possible the accuracy of these conclusions, Dr. Phelps says that he conducted experiments upon four dogs. Describing these operations, Dr. Phelps says:—

“The difficulty of keeping limbs of animals lashed in one position for a long period, together with the possibilities of disease and excoriations, will, I think, be apparent to all. . . . They do not bear confinement well in a cramped, unnatural position. However, with all these difficulties to overcome, we succeeded in keeping one dog six weeks, one dog three and one-half months, and two for five months lacking one week.

“The first dog, killed at the end of six weeks, was less than one year old. He had been dressed in the following manner: Under ether, the hind leg was carefully dressed with cotton batting. Over this was applied a roller and a plaster-of-Paris bandage, the leg being held in a straight position until the plaster became hard. The body of the dog was now similarly dressed with the cotton batting and roller. A few turns of the plaster-of-Paris around the body, finally including the leg, which was drawn well up over the back of the dog, completed the work of immobilising. . . . This secured the hind leg to the plaster cast, which was closely fitted to the body, making dog, cast, and leg one piece, as it were.

“The leg being drawn up over the back in this intentionally cramped position, induced considerable intra-articular pressure at the hip-joint by putting the muscles and ligaments upon the stretch, the leg being used as a lever.

“The dog did very well for a few weeks, there being but slight rise of temperature. But at the end of the fifth week he refused to eat and began to emaciate. A week later, on the forty-second day, he was killed. An excoriation, due to pressure, was found below the knee upon removing the dressing. This accounted for the loss of appetite, as much pain must have been induced.

“The other three dogs were treated similarly to the first, only the fore leg was substituted for the hind leg. The fore leg is easily secured to the body immovably with plaster-of-Paris. . . . To prevent the dogs from gnawing the dressing away, which they

would surely do if allowed, the plaster-of-Paris bandage was carried forward on to the neck, making a stiff collar, which kept the heads always to the front. This precaution will be found useful in other kinds of experiments to prevent dogs from using their teeth upon dressing or apparatus.

"Dog No. 2 was killed at the end of three and one-half months. . . . Dogs Nos. 3 and 4 developed mange, and were killed at the end of the fifth month, lacking one week (145 days)."

With the description of each experiment, Dr. Phelps gives the *post mortem* appearance of the joint. From the experiments he concludes that a normal joint may be immobilised for five months without ankylosis resulting, that motion is not necessary to preserve the normal histological character of the joint, that ankylosis in such cases is due to pathological causes, that immobilisation causing intra-articular pressure will result in destruction of the head of the bone and the socket against which it presses, and that atrophy or wasting of the muscles will follow prolonged immobilisation.—*New York Times*, Nov. 26, 1890.

MISCELLANEOUS TORMENTS.

(C.)

*DESTROYING BRAINS TILL THE ANIMAL
BEHAVES LIKE A JACK PUDDING.*

Foreign. On pages 429 and 430 Professor Goltz speaks of two dogs rendered imbecile by the loss of a part of the brain : "The awkward movements of one gave the impression of a Jack Pudding."—*Pflüger's Archives*, Vol. XIV. (1887).

MISCELLANEOUS TORMENTS.

(D.)

CLAMPING NATURAL ORIFICES.

Foreign. Experiments made in the Physiological Institute at Königsberg, by Dr. M. Blitstein, practising physician, and Dr. W. Ehrental, assistant at the Institute. These experiments were made solely on dogs, and during a period of a year and a-half, at the instigation and under the supervision of Professor Hermann. At the very commencement of their paper, the authors have to allow that some of the results they observed may have been partly attributable to the disturbances caused by the experiments themselves. These experiments were of three kinds:—1. Circular suture experiments; 2. Starvation experiments on dogs, in which biliary fistula had been established; 3. Observations on dogs, in which an artificial *anus* had been formed, and the natural aperture closed up. The dogs destined to be starved were subjected to excision of a portion of the *ductus choledochus*, the gall bladder opened, and the edges of the wound sewn to the outer skin. One dog bore starvation for nineteen days before death. Another dog only needed seven days to kill it. The circular suture was practised on ten dogs. Five died of suppurative peritonitis at various periods; the others were killed, also at various periods, after the operation. —*Pflüger's Archives*, Vol. 48, 1890, p. 74, &c.

Foreign. Mantegazza clamped the vents of rabbits and guinea-pigs before placing them to be tortured in the *Tormentatore*.—*See Del Dolore*, pp. 102-3.

MISCELLANEOUS TORMENTS.

(E.)

SPINNING.

1. BY LESION OF BRAIN.

Foreign. Goltz destroyed the ear labyrinths in birds, causing them to die soon after the operation with violent rolling movements or somersaults.—*Pflüger's Archives*, Vol. III., p. 177-78.

2. ON REVOLVING TABLE.

Foreign. Heimann, with the permission and aid of Professor Kronecker, constructed a round disc or circle with high edges. This apparatus could be turned by gas-power from 2 to 300 times in one minute, and the revolutions repeated three or four times with pauses of one minute. Dogs, frogs, and guinea-pigs and rabbits were bound to this disc belly downwards; their legs stretched before and behind; the head and under-jaw lying in such a way on the disc that one-half of the skull was peripheral and the other central to the revolutions. Most severe dizziness was the first result; a flow of saliva; nystagmus, and so forth. Then resulted paralysis on that side of the animal nearest the middle of the disc. On being released, the creature fell on the paralysed side, no longer able to walk or move. Various experiments, with variations, were performed on these animals. For instance, Prussian blue was injected into the arteries by means of an india-rubber tube, and driven partly by centrifugal force into the head of the animal. Others had half their blood drained away; holes were made in the brains of others, into which cork was put.—*See Du Bois Reymond's Archives*, 1884, p. 579.

Foreign. Mendel, E., of Berlin, made a round disc; bound dogs on this, and set it turning or spinning. When the head of the dog was towards the

periphery of the disc, and its legs towards the centre, the *post mortem* showed intense hyperæmia of the bones of the skull, the membranes of the brain, and the grey cortical substance. When the disc rotated at a speed of 125 to 130 turns a minute, the animals died after from 25 to 30 minutes of this treatment. When the rotations were slower—100 to 110 turns in a minute—giddiness ensued, but the same dog lived under this treatment for from 12 to 14 days, enduring the rotations three or four times daily, with short pauses between. Muscular sensation in the hind legs was then lost. The animals were then well fed and no longer bound to the disc; but in the course of the following week their fore legs also became lame; they lost the power of moving, their voices became altered, and in the second week they became first stupid, and then idiotic. Their bodily weight diminished, and death followed from general paralysis.—*Sitzungsbericht der Berliner Akademie der Wiss.*, 1884, p. 393.

Foreign. Dr. A. v. Koranyi, in Buda Pest, and Dr. F. Loeb, at Naples, have studied nystagmus by making experiments on the brains of rabbits and dogs. Dr. Loeb, as far back as 1886, had reported his experiments on dogs, the left hemisphere of whose brain he had injured. "Rabbits, from whose brain we extirpated a portion of the hemisphere (always on the left side), were fixed on a horizontal support, made to rotate round a vertical axis. The support was made to revolve ten times continuously in one direction, either to the left or to the right; then the machine stopped, and the number of oscillations of the animal's eye was recorded." Some of the rabbits had portions of the back of the brain destroyed, and the rotary motion was tested for more than a month. In a dog the result did not prove similar:—" . . . In a dog operated upon in the left hemisphere an inclination to turn frequently to the left was observed. Thus the physical disturbance had an effect contrary to that on rabbits, who preferred turning to the right. In the dog also the compensatory motion was in accordance with the spontaneous motion. The dog with his brain destroyed on one side compensates well the motion of the centrifugal machine, which forces him to turn towards the side of his injured hemisphere. We have had occasion to convince ourselves anew of this fact on two dogs, the posterior portion of whose brain was operated upon long before by Loeb."

A lady (Fraulein Tomasiewicz) describes experiments in which rabbits with auditory nerve cut were submitted to the action of the wheel and electrical stimulation.—*Pflüger's Archives*, Vol. 48 (1891), p. 423, &c.

Foreign. Some fresh experiments, by Zin Gutnikow, of Charkow, under the supervision of Prof. Obersteiner, were begun in October, 1890. The instrument used is described as consisting of two wheels fixed to a stand. The smaller wheel, worked by the operator, communicated its movement with an increased velocity of three to one to the larger wheel by means of a band. The method of noting the time of death was, we are told, "*exceedingly simple*." The animals (guinea-pigs) were fixed on the wheel, which was made to revolve rapidly. After the animal was fastened, the ear, nose, or any sensitive part was pinched till the animal uttered a cry. As the wheel turned "the centrifugal force caused a tendency in the pincers to come away from the object pinched," that is to say, the strain on the pincers became greater, and the guinea-pigs shrieked all the more. At first the cry uttered is very loud, then it becomes weaker, and ceases suddenly after about a minute and a-half. By that time the animal is sometimes dead, or if not dead is senseless, and is allowed three days to recover, that it may be used for fresh experiment. Guinea-pigs generally die in one and a-half to two minutes. A number of experiments were performed by the author in precisely similar conditions, and with exactly opposite results; sometimes he found the brain hyperæmic, sometimes anæmic.

Besides being made simply to rotate on the wheel, in 42 carefully chosen healthy guinea-pigs a half-centimetre length of the sciatic nerve was cut away. An animal apparently dead may occasionally, but not often, show signs of life when the skin of the head is cut through. (It is a very painful operation to cut through this skin, and the pain stimulates and revives the animal.) To make sure that he had cut nerve, "and not something else," each piece was examined carefully under the microscope. Five days after the operation one animal died of violent inflammation of the operated spot; two days later another died. Of the others, in some epileptic convulsions were easily induced, in others not; and the author says that those who were submitted to the same

disturbance of the nervous system did not become epileptic "for reasons unknown." The guinea-pigs in which the disease could not be induced by the cutting out of the portion of nerve were to be made epileptic by being turned on the wheel; half the number with their heads towards the centre, the other half with their heads towards the circumference. The latter series (with the heads outwards) all died, after being turned, at intervals of 24 hours, nine times. All died within 48 hours of the last experiment; two were taken dead from the wheel, the other eight had repeated attacks of epilepsy. The others (with heads towards the centre) did not die, except one, but lost their appetite, sat listlessly with heads hanging, and uttering a cry only when pinched. These in their turn were put on the wheel till they died, either immediately or a few days later. Two only who were alive when the experiment was interrupted were found dead in their cage the following morning. It would appear as if these two last unfortunate guinea-pigs were turned on the wheel in different directions for $9 + 15 + 8 = 32$ experiments before death came to release them some time after the last experiment was, as above stated, interrupted.

The author, in communicating the foregoing results, mentions that he is continuing his researches in the same direction.—"Experimental Researches on Anæmia and Hyperæmia of the Brain by Zin Gutnikow."—*Pflüger's Archives*, Vol. 49, pp. 609, &c.

Foreign. Professor Ugolino Mosso has tried to find out whether pain would cause high temperature in animals, the results he obtained being contrary to those obtained by Mantegazza. For this purpose, he had constructed an apparatus consisting of two wheels turning on a large pivot working horizontally and capable of holding at the same time two fair-sized dogs. As the dogs scrambled in, the wheels were set in motion, and escaped from them like the wheels in squirrels' cages. When required that the dogs should go round for several hours without rest at a rapid pace, the wheel was turned by a gasmotor. One dog was made to fast 24 hours and then made to run in the wheel at the rate of 115 metres a minute, or 6,900 metres an hour for six consecutive hours. A blind dog was put in, but he had to be taken out at the

end of an hour with legs bleeding, because he allowed himself to be dragged along helplessly. Another old dog which had been starved was taken out with his legs bleeding at the end of two hours, as it could no longer stand. Prof. Mosso says:—"In our laboratory of physiology, where we have been studying the effects of fatigue on dogs, I have been able to note a surprising rise in the temperature each time the dogs wounded their legs during their travels on the wheel. This rise of temperature was always accompanied by scratches, excoriations, and wounds in the legs, and these wounds were frequently so considerable that their nails bled, because the dogs offered so much resistance to the machine that was carrying them on. I attributed the rise of temperature to the pain which the animals must have suffered as they struggled against the impetus which was carrying them on against their will."—*Archives Italiennes de Biologie*, Vol. VII., 1886, p. 312, etc.

MISCELLANEOUS TORMENTS.

(F.)

STIFFENING A DOG "LIKE A PIECE OF WOOD."

Foreign. "Let us come to the description of the convulsive attack" (produced by placing the victim for hours under compressed oxygen pumped through a tube into its trachea). "It is really curious and frightful (*effrayant*)."

"Let us take a case of medium intensity. When the animal is taken out of the machine it is generally in full tonic convulsions. The four paws are stiffened, the trunk is recurved backwards and a little sideways, the eyes are starting from the head, the pupil dilated, the jaws clenched. Soon there is a sort of relaxation to which succeeds a new crisis of stiffening with clonic convulsions, resembling at once a crisis of strychnine poisoning and an attack of tetanus. . . . Sensibility is preserved. . . . One may lift the animal by one paw *like a piece of wood*. In slighter cases we observe disordered movements and local convulsions," &c.—*La Pression Barométrique*, by Paul Bert, pp. 794, 800.

[This is experiment No. CCLXXXVI. in M. Bert's book, and in his picture, exhibited in the *Salon*, he is represented in the act of performing it and holding up the dog. Experiment CCXCVII., to similar purpose, was performed on a female dog before the Academy of Science, 24th May, 1874. There are more than 500 experiments detailed in M. Bert's book.]

MISCELLANEOUS TORMENTS.

(G.)

EXCHANGING BRAINS, EXPLODING

DOGS, &c.

GROTESQUE EXPERIMENTS.

Foreign. "Two large dogs, A. and B., were simultaneously trephined (by Dr. Gilman Thompson) over the right occipital region; 8 cubic centimetres of brain tissue were excised in one piece and exchanged; the piece from dog A. was put into the opening in the brain of dog B., and *vice versâ*. On the third day both dogs were killed, and the transplanted pieces of brain tissue looked normal, and in each case they were so adherent and firmly covered with fibrous exudation that it was impossible to pull them off with forceps without laceration. Total blindness of the eye opposite the lesion resulted in each dog, as was expected. In another case, 1.5 cubic centimetre of brain was removed from the occipital region of a cat and transferred to a corresponding position in the brain of a large dog, which was killed at the end of seven weeks, when the piece of transplanted cat's brain was found firmly adherent to the dog's brain, with the *pia mater* intact. Careful microscopical examination was made, and it was found that there was complete union, through organised connective tissue, of the contiguous portions of the two brains. There was descending secondary degeneration of the dog's brain on the side of the graft, as is usual in cases of simple excision of brain cortex; hence the cat's cortex had not succeeded in acting as a nutrient centre for the dog's brain."—*New York Medical Journal*, Vol. II., p. 701, quoted in *British Medical Journal*, July 12, 1890, p. 94.

Foreign. At the late Medical Congress, held in Berlin, a Philadelphia Professor performed before the assembled doctors some experiments upon a dog. A French

journal, in describing it, says that the Professor "roared out: 'Hand me over that dog.' The unfortunate animal was brought into the room carefully muzzled, and with its legs tied down. The Professor then proceeded to pump the poor beast full of sulphuretted hydrogen gas. 'Now, gentlemen,' he shouted, 'the gas will issue from his mouth in a stream, and I will set fire to it.' A lighted match was set to the dog's mouth with no result, a second, a third, a whole box full, and nothing came out of it but burning the hair on the dog's jaws." Then came the second part of the experiment: "'Now, gentlemen,' said the Professor, 'you will see the effect when the gas has been pumped into the bowels *when they have been wounded*.'" He then produced a loaded revolver and fired a bullet into the wretched animal's abdomen. The dog yelled piteously, and the bleeding creature was subjected to a repetition of the gas injection. The rest of the story was too horrible to tell even in the pages of an English medical journal."—*Philadelphia Ledger*, Dec. 16, 1890.

Foreign. "Dr. Majendie says, 'It is curious to see the animals skip and jump about of their own accord, after you have taken out all their brains a little before the optic tubercles;' and as to 'new-born kittens,' he says, 'they tumble over in all directions, and walk so nimbly, if you cut out their hemispheres, that it is quite astonishing.'"—*Journal de Physiologie*, t. iii., p. 155.

MISCELLANEOUS TORMENTS.

(H.)

TRYING TO INDUCE SUICIDE BY AGONY.

The following description, from the pen of an English professor, now engaged at Bristol University College, relating to experiments performed by himself, is reprinted from *Nature* of February 1, 1883. As will be gathered from the recital, these barbarous procedures were prompted by no higher motive than that of curiosity.

English. Speaking of scorpion snicide, Mr. G. J. Romanes in his "Animal Intelligence" quotes: "Still I think that so remarkable a fact unquestionably demands further corroboration before we shall be justified in accepting it unreservedly" (p. 225). Some years ago I made some experiments and observations on a smaller and a larger species of scorpion found on the Cape Peninsula. I am unable to ascertain the specific names, the smaller are found beneath the bark of decaying tree-stumps, the larger, which often weigh upwards of seventy grains, are found beneath stones and ant-balls. I have recently resumed these experiments and observations. The conclusion I came to is that neither of these species have any suicidal instinct. Only in one case have I found, after death, any sign of such a wound as the sting might inflict; in this case, though one of the tergal plates showed a largish irregular fracture, the wound did not seem a fresh one, and was dry and apparently skinned over; in this case, too, though I watched the death of the scorpion (caused by the gradual application of heat to the bottom of the glass vessel in which the creature was inclosed), I was not able to detect anything like the act of suicide. I will now briefly describe the nature of my experiments.

1. Condensing a sun-beam on various parts of the scorpion's body. The creatures always struck with the sting round, across, and over the heated spot, and seemed to try and remove the source of irritation.

2. Heating in a glass bottle. As this admits of most careful watching, I have killed some twenty or thirty individuals in this way. The creatures very commonly pass the sting over the body as if to remove some irritant. The poison exudes from the point of the sting and there coagulates.

3. Surrounding with fire or red-hot embers. I first took a newspaper, moistened a ring about a foot in diameter with alcohol, and placed a scorpion within the ring. The paper was, by this time, ignited. He walked without hesitation through the fire, and tried to make his escape. I made a ring of red-hot wood-embers, and placed a scorpion in the middle. He pushed his way out, displacing two of the embers. I made a better fire-wall, and put him in the middle again. He crept over the embers. I placed him in the midst of a ring of embers on the flat and much-heated stones of the fire-place. He crept over the embers again, but this time got baked before he could escape.

4. Placing in burning alcohol. I placed a layer of an eighth of an inch of alcohol in a shallow vessel, lit the alcohol, and placed the scorpion in the midst of the burning spirit.

5. Placing in concentrated sulphuric acid. I moistened the bottom of a large beaker with a very thin layer of concentrated sulphuric acid, and put in a scorpion. The creature died in about ten minutes. (I have also tried other strong acids, a concentrated solution of sodium hydrate, and a potassium cyanide solution.)

6. Burning phosphorus on the creature's body. I placed a small pellet of phosphorus near the root of the scorpion's tail, and lit the phosphorus with a touch of a heated wire. The creature tried to remove the phosphorus with its sting, carrying away some of the burning material.

7. Drowning in water, alcohol, and ether.

8. Placing in a bottle with a piece of cotton-wool moistened with benzene.

9. Exposing to sudden light. I have not tried special experiments as to this point, but have, on turning over an ant-ball, suddenly exposed a scorpion, hitherto in complete or almost complete darkness, to the full glare of South African sunshine.

10. Treating with a series of electric shocks.

11. General and exasperating courses of worry.

I think it will be admitted that some of these experiments were sufficiently barbarous (the sixth is positively sickening) to induce any scorpion who had the slightest suicidal tendency to find relief

in self-destruction. I have in all cases repeated the experiments on several individuals. I have in nearly all cases examined the dead scorpion with a lens. My belief is that the efforts made by the scorpion to remove the source of irritation are put down by those who are not accustomed to accurate observation as efforts at self-destruction. On one occasion I called in one of my servants to watch the death of a scorpion by gradually heating it in a glass bottle. The creature at once began moving its sting across and over its back, upon which my servant exclaimed, "See, it is stinging itself." I do not wish to imply that all the cases of alleged scorpion suicide are merely instances of careless observation. All I wish to do in this note is to record my individual experience, and to state clearly that after making a series of observations as carefully as I could on a large number of individuals, I cannot place on record a single instance of clear and unmistakable scorpion suicide.

C. LLOYD MORGAN.

Rondebosch, January 1.



NINTH CIRCLE.

MORAL EXPERIMENTS
ON
ANIMALS.

MORAL EXPERIMENTS.

(A.)

TESTING A DOG'S FEELINGS.

Foreign. "Dr. Brachet says: 'I inspired a dog with the greatest aversion for me by plaguing and inflicting some pain or other upon it, as often as I saw it; when this feeling was carried to its height, so that the animal became furious as soon as it saw or heard me, I put out its eyes. I could then appear before it without its manifesting any aversion. I spoke, and immediately its barkings and furious movements proved the passion which animated it. I destroyed the drum of its ears, and disorganised the internal ear as much as I could; and when an intense inflammation which was excited had rendered it deaf, I filled up its ears with wax. It could no longer hear at all. Then I went to its side, spoke aloud, and even caressed it, without its falling into a rage,—it seemed even sensible of my caresses.' Dr. Brachet repeated the same experiment on another dog, and assures us that the result was the same."

—*Human Physiology*, by John Elliotson, M.D., F.R.S., p. 450.

(B.)

AMPUTATING BREASTS OF MOTHERS
NURSING THEIR YOUNG.

Foreign. Prof. Goltz says it was "marvellous and astonishing" to find that a dog that had served for some seven experiments, whose breasts had been cut off, whose hind quarters were completely paralysed, and whose spinal marrow had been destroyed, the animal suffering afterwards from fatal peritonitis, was still capable of maternal feelings for its young. "She unceasingly licked the living and the dead puppy, and treated the living puppy with the same tenderness as an uninjured dog might do."—*Pflüger's Archives*, Vol. IX., p. 564. [The spinal marrow was destroyed under chloroform, which of course did not prevent the paralysis nor the after suffering from the excision of the breasts.—ED.]

Foreign. *On the Influence of the Nervous System during Pregnancy*, by Dr. Goltz in Strasburg and Dr. A. Frcusberg.—"On female guinea-pigs, which have only a single pair of mammæ, we have made an ablation of the glands during lactation.—*Manuel Pratique de Gynécologie*, L. de Sinéty, Paris, 1879, p. 778.

Foreign. For Paul Bert's reports of his experiments in amputating the breasts of a goat and other animals, See *Comptes Rendus de la Société de Biologie*, Paris, 1883, p. 193.

Foreign. I wrote to communicate to the Society the results that I have obtained by the ablation of mammæ in animals. Dogs and rabbits with their six or eight mammæ are unable to survive these experiments.

"I have myself made a fair number of experiments relative to the innervation of the mammary glands on female guinea-pigs. . . . Considering the contrary results, it would be well to describe the experiments before arriving at any conclusions. . . . Experiments No. 1, June 10, 1874. Guinea-pig in lactation. The mammary nerve on one side is laid bare, and insulated by means of a thread. The animal exhibits signs of acute pain, especially when the nerve is stimulated by an electric current."

I have selected five experiments from those I had noted down in my book, as I made them under varying conditions. In all of them the results were negative. . . . Roehrig observed that in the goat the effects were different, as Laffont had said, which proves once more that the conclusions arrived at must not be too much generalised.—*De l'Innervation de la Mamelle*, by M. de Sinéty, *Rep. Société de Biologie*, Oct. 25, 1879, *Gaz. Méd. de Paris*, 1879, p. 593.

APPENDIX A.

The following is an abstract of the law relating to vivisection, taken from the *Medical Directory*, 1892, p. 17. "By 'The Cruelty to Animals' Act, 1876,' 39 & 40 Vict., c. 77. Painful experiments on animals are prohibited, under heavy penalties, except subject to the restrictions imposed by the Act. The restrictions are that the experiment must, in every case, be for medical or physiological purposes; that the operator must be licensed under the Act; that the animal must be under an anæsthetic, and must be killed before it recovers therefrom if it be seriously injured, or the pain be likely to continue; and that the experiment must not be performed as an illustration of a public lecture, or for the purpose of obtaining manual skill. Most of these restrictions may, however, be relaxed on a certificate being obtained, in manner provided by the Act, setting forth valid reasons for such relaxation. There are also special restrictions as to the performance of painful experiments on horses, asses, mules, dogs, and cats. No public exhibition of painful experiments may be given or advertised. Persons aiding in performing such experiments illegally are subject to penalties. Licenses are granted by the Secretary of State, who has powers to compel the registry of places in which such experiments are to be performed, to cause such places to be visited by inspectors, and to direct any persons making such experiments to report the results to him. Applications for licenses must be signed by one or more of the Presidents of certain medical, surgical, and scientific bodies specified in the Act, and countersigned by a university Professor of physiology, medicine, anatomy, medical jurisprudence, *materia medica*, or surgery, not being the applicant himself. A Judge has power to license such experiments when he deems them essential for the purposes of justice in a criminal case. No prosecution under the Act can be instituted against a licensed person without the assent in writing of the Secretary of State. The Act does not apply to invertebrate animals."

Objection is raised to the Act on the following grounds:

1. Because under it are licensed the very men whose deeds and writings a few years ago raised so strong a feeling of abhorrence

in the public mind that the Royal Commission was called for. One of the witnesses who candidly admitted that he had "no regard at all" for the animals' sufferings has been regularly licensed since 1884.

2. Because when a man is once licensed there is absolutely no limit in duration or intensity to the suffering he may inflict.

3. Because the qualifications for obtaining a licence do not depend at all on the applicant's moral character, but wholly on his scientific training; and the members of the scientific societies and the professors who vouch for its competence are themselves vivisectors or in favour of the practice, and thus they practically recommend each other.

4. Because all the inspectors hitherto appointed have been vivisectors or keen partizans, one of them having called our movement "a mischievous and senseless agitation."

5. Because the Parliamentary Returns, as their wording shows, are compiled, not from personal observation, but from the statements furnished by the vivisectors themselves. Accounts of horrible experiments published in scientific journals thus never appear in the Returns or only in such a form that they cannot be recognised.

6. Because curari, though not recognised as an anæsthetic, may still be used in conjunction with real anæsthetics. The administration of chloroform, morphia, &c., is well known to be difficult, and to need the most careful watching; but when the animal is rendered perfectly motionless by curari there is no means of telling whether the other drug is having any effect or not, or whether the curari is itself sufficiently strong to exercise an anæsthetic effect.

7. Because no licensed person can be prosecuted under the Act without "the consent in writing of the Home Secretary." Previous to this Act the vivisector was liable to be prosecuted under Martin's Act, but now he is safe; and thus the Vivisection Act, instead of protecting the animals, in reality protects the offender.

8. Because it is not based on any definite principle, and the parties chiefly concerned, viz., the animals, have been considered least. It is in reality a compromise made in the hope of satisfying two opposing parties. To please the humanitarians vivisection is prohibited under heavy penalties; to pacify the physiologists it is again allowed by a system of licences and certificates; and between the two the animals' interests have been left out and they are practically worse off than before.

APPENDIX B.

The Inspector's report for 1891 gives the following information :—

“ The total number of experiments performed in 1891 was 2,661.

“ Of these there were performed—

“ Under license alone	875
„ Certificate A.	1,363
„ Certificate B.	210
„ Certificate C.	111
„ Certificate D. + A. (included under A.) ..	—
„ Certificate E. + A. or B.	94
„ Certificate F. + A.	8
Total	2,661

The Classification of the Certificates is thus explained by the Inspector :—

A.	B.	C.	D.	E.	F.
Special for Experiments without Anæsthetics.	Dispensing with the Obligation to kill the Animal before Recovering from Anæsthesia.	Permitting Experiments in Illustration to Lectures.	For the further Advance- ment of Knowledge by testing previous Dis- coveries.	Permitting Experiments on Cats or Dogs, or without Anæsthetics. (always coupled with A. or B.)	Permitting Experiments on Horses, Mules, or Asses.

This Return shows that since the year 1876, when the Act first came into force, the number of licensed vivisectors has increased from 23 to 152, and that of licensed places from 19 to 66, while the number of experiments during each 12 months has risen from 481 to 2,661; of which those made without anæsthetics have increased from 164 to 1,406.

APPENDIX C.

The history of the first edition of the *Nine Circles* and the explanation of—and apology for—the errors found in it, were given by Miss Cobbe in her speech at the meeting in St. James's Hall, October 27, 1892. Miss Cobbe said:—

“Now to come to the story of the *Nine Circles*, which I will tell as quickly as possible. When I gave up the Honorary Secretaryship of the Victoria Street Society six years ago, I retired to live among the mountains in Wales; and the chief thing which remained for me to do was to publish as many pamphlets and papers as seemed likely to help the cause. I have just got here my printer's list of the papers which I have printed in those six years. I have made up the totals, and I find that the number in the six years of books, pamphlets, and leaflets has been 320—that is about one a week—and that 271,350 copies of them were printed, of which 173 were written by myself. (Cheers.) Some of these were adopted by the Society and honoured by coming out under its auspices; and others I issued quite independently. Amongst those which I issued “on my own hook,” I am happy to say, was this book called the *Nine Circles*. Therefore, our dear and honoured Society is not responsible for that book. I am alone responsible; it was printed at my expense, and Messrs. Sonnenschein published it for me. Therefore, I am the only person concerned with it, and the Society has nothing to do with it. I am thankful to hear that the revised edition will come out under the auspices of the Society. My only privilege will be to pay for it, and that I shall most thankfully do, in order to wipe out the wrong I have done as concerns the present edition. When the present book was got up, I sketched a plan of it, and asked my much respected and esteemed friend, Mrs. Rhodes, who was living in London, and who is a good German scholar, to make extracts for me. She knows a great deal about the subject, she also knows German (which I do not), and she was living in London while I was 200 miles away. Therefore I asked her to make the extracts of which this book is compiled, and it was afterwards revised,—as

Dr. Berdoe has told us,—by him. The book came out; and it appears now that there are some mistakes in it. Mrs. Rhodes had not attended to all the details as I had desired; and she left out certain things which ought to have been stated. I took it for granted—I was quite wrong to do so—that all my directions had been carried out, and I made myself responsible for this book. Therefore, whatever error there is in the matter is mine, and I beg that that will be quite understood. I throw myself upon your mercy, and I hope you will all consider me in the light of an old watchdog who has barked very conscientiously at the tramps for a long time, but once he has given a growl when there was no proper cause for it, and is much ashamed of it,—as every good dog would be. (Cheers.) But what is all this tremendous storm which has been raised, and this pulling of the house down about these mistakes? Do they wish us to understand that there are no such things as painful experiments in England? Apparently that is what they are trying to make us think—that there never has been anything of the kind; that they are perfectly incapable of putting any animal to pain. Do they really mean that? Is that what they wish us to understand? If they do *not* mean that, I do not know what they do mean. It seems to me that they are raising this tremendous storm very much as if the old slave-holders were to have danced a war-dance round Mrs. Stowe, and scalped her for having said that Legree had flogged Uncle Tom with a thousand lashes, when really there were only nine hundred and ninety-nine. (Laughter.) That seems to me to be the case in a nutshell.”—*Zoophilist*, November 1, 1892.

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